PB84-225812

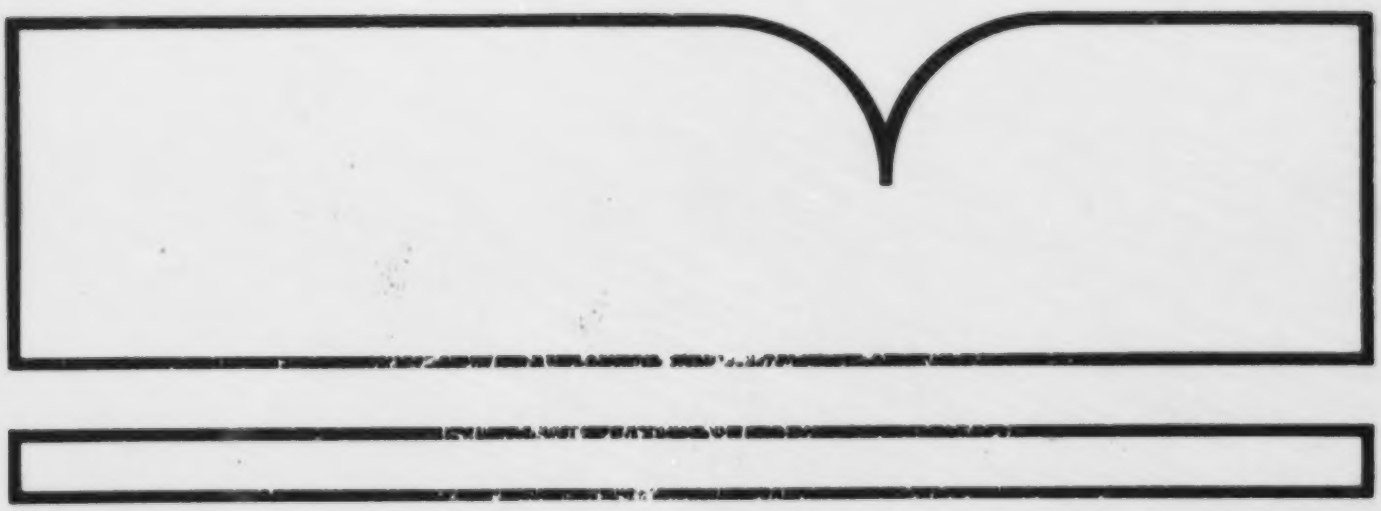
# Control of Industrial VOC (Volatile Organic Compound) Emissions by Catalytic Incineration. Volume 6. Catalytic Incinerator Performance at Industrial Site C-4

Radian Corp., Durham, NC

Prepared for

Industrial Environmental Research Lab.
Research Triangle Park, NC

Jul 84



U.S. Department of Commerce
National Technical Information Service
NTIS

PB84-225812

EPA-600/2-84-118f
July 1984

# CONTROL OF INDUSTRIAL VOC EMISSIONS BY CATALYTIC INCINERATION
## Volume 6. Catalytic Incinerator Performance at Industrial Site C-4

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**TECHNICAL REPORT DATA**
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| | |
|---|---|
| 1. REPORT NO. EPA-600/2-84-118f | 2. |
| 3. RECIPIENT'S ACCESSION NO. PB84-225812 | |
| 4. TITLE AND SUBTITLE Control of Industrial VOC Emissions by Catalytic Incineration; Volume 6. Catalytic Incinerator Performance at Industrial Site C-4 | 5. REPORT DATE July 1984 |
| | 6. PERFORMING ORGANIZATION CODE |
| 7. AUTHOR(S) K.K. Fidler and Michael A. Palazzolo 83 | 8. PERFORMING ORGANIZATION REPORT NO. 203-001-50-30 |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS Radian Corporation 3024 Pickett Road Durham, North Carolina 27705 | 10. PROGRAM ELEMENT NO. |
| | 11. CONTRACT/GRANT NO. 68-02-3171, Tasks 39 and 50 |
| 12. SPONSORING AGENCY NAME AND ADDRESS EPA, Office of Research and Development Industrial Environmental Research Laboratory Research Triangle Park, NC 27711 | 13. TYPE OF REPORT AND PERIOD COVERED Final; 5/82 - 8/83 |
| | 14. SPONSORING AGENCY CODE EPA/600/13 |

15. SUPPLEMENTARY NOTES IERL-RTP project officer is P. J. Chappell, Mail Drop 63, 919/541-3738.

16. ABSTRACT The report is part of a two-phase EPA effort to assess the performance, suitability, and costs of various technologies to control emissions of volatile organic compounds (VOCs). In Phase 1, information was assembled from the literature on the use and cost of using catalytic incineration for VOC control. Results included: (1) a review of current and developing catalytic incineration technology, (2) an assessment of the overall performance of catalytic incinerators, (3) a review of applications where catalytic incinerators are used, (4) a comparative analysis of catalytic incineration with other competing VOC controls, (5) an examination of available methods for emission testing catalytic incinerators, and (6) an assessment of the need for additional performance test data. Phase 2 was a test program designed to increase the catalytic incinerator performance data base. It resulted in reports documenting the performance of eight catalytic incinerators at six industrial sites. The incinerators were used to control VOC emissions from solvent evaporation processes at can coating, coil coating, magnet wire, and graphic arts printing plants. Performance was measured at several process conditions at each site. Incinerator performance was characterized in terms of destruction efficiency, outlet solvent concentration, and energy usage. Design and operating data were collected.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group | |
|---|---|---|---|---|
| Pollution | Magnet Wire | Pollution Control | 13B | 11F, 20C |
| Incinerators | Graphic Arts | Stationary Sources | | 14E |
| Catalysis | Printing Equipment | Catalytic Incineration | 07D | |
| Organic Compounds | | Volatile Organic Compounds | 07C | |
| Volatility | | | 20M | |
| Solvents | | Solvent Evaporation | 11K | |
| Evaporation | | Can Coating | | |

| | | |
|---|---|---|
| 18. DISTRIBUTION STATEMENT Release to Public | 19. SECURITY CLASS (This Report) Unclassified | 21. NO. OF PAGES 94 |
| | 20. SECURITY CLASS (This page) Unclassified | 22. PRICE |

EPA Form 2220-1 (9-73)

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## ABSTRACT

The emission of volatile organic compounds (VOCs) from industrial plants significantly increases ambient levels of photochemical oxidants, ozone, and smog. Control of industrial VOC emissions, therefore, can result in substantial environmental benefits. This study was part of a comprehensive effort by EPA/IERL-RTP to assess the performance, suitability and costs of various VOC control technologies. The objectives of the EPA program were two-fold:

(1) to provide an overview of how catalytic incineration is applied to control industrial VOC emissions and to assess the overall performance, applicability, and costs as compared to alternate VOC control technologies, and

(2) to gather actual performance data through a field testing program on existing operating industrial catalytic incinerators.

The task of meeting these objectives was accomplished in two phases. In the first phase, information was assembled from the literature on the use and cost of using catalytic incineration for VOC control. This phase of the study provides results in the following areas:

- A review of current and developing catalytic incineration technology,
- an assessment of the overall performance of catalytic incinerators,
- a review of applications where catalytic incinerators are used,
- a comparative analysis of catalytic incineration with other competing VOC controls,
- an examination of the available methods for emission testing catalytic incinerators, and
- an assessment of the need for additional performance test data.

The second phase was a testing program designed to increase the catalytic incinerator performance data base. The testing program was planned so that 8 catalytic incinerators at industrial sites would be tested.

The outputs from this phase of the program consisted of a series of reports documenting the performance of 8 catalytic incinerators at 6 industrial sites. All 8 incinerators were used to control VOC emissions from solvent evaporation processes. Incinerators at can coating, coil coating, magnet wire, and graphic arts printing plants were tested. The performance measurements were made at several process conditions at each of the sites visited. Incinerator performance was characterized in terms of destruction efficiency, outlet solvent concentration, and energy usage. Incinerator design and operating data, such as operating temperature, solvent type, catalyst volume and age, were collected to document the operating conditions during the tests.

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# SECTION 1

# INTRODUCTION

Radian Corporation is conducting a testing program for the EPA (Contract No. 68-02-3171, Work Assignment 50) to document the performance of catalytic incinerators applied to industrial processes for volatile organic compound (VOC) control. Performance data collected at each test site is being summarized in a series of test reports (Volumes 3-8). A final report (Volume 2) presents comparative results of data from all test sites. This report presents test results from the incinerator at Plant C-4, a metal decorating plant.

VOC emissions are of concern to the EPA because they may react photochemically in the atmosphere to form photochemical oxidants. National Ambient Air Quality Standards (NAAQS) for photochemical oxidants are routinely exceeded in many areas of the United States. The objective of the current program is to gather performance data on industrial catalytic incinerators. This data will allow the EPA and industry to assess the potential reduction in VOC emissions that can be expected from using catalytic incinerators on various industrial processes. For purposes of discussion, the term VOC is used throughout this report to mean any volatile organic compound in the gas stream sampled.

The approach taken to evaluate the performance of industrial catalytic incinerators consisted of (1) developing plant-specific test plans and test methods to characterize incinerator performance and (2) performing several days of comprehensive on-site testing for each incinerator. Testing focused on the simultaneous monitoring of inlet and outlet VOC concentrations and measurement of incinerator operating conditions.

Incinerator destruction efficiencies presented in this report were determined by measuring inlet and outlet VOC concentrations according to EPA Method 25A. The Method 25A results represent total hydrocarbon (THC) concentrations in the gas streams on a carbon ($C_1$) basis. These THC values were determined by comparing the flame ionization detector (FID) response of the multicomponent gas streams sampled to the FID response of propane standards. The THC values represent a single FID response to a mixture of solvents and not the sum of responses to individual solvents in the mixture. The THC concentrations presented in this report cannot be compared to the percentages of individual components in the gas streams.

This report is divided into 4 sections beyond the Introduction (Section 1.0). Section 2.0 provides a summary of the results of the test. Section 3.0 gives a detailed process description and Section 4.0 discusses the sampling and analytical methods used at the site. The results of testing and analysis are presented in Section 5.0.

## SECTION 2

## SUMMARY

A catalytic incinerator at Plant C-4, a decorative metal can manufacturing plant, was performance tested between January 31 and February 5, 1983. Testing focused on characterizing the effects of operating parameters on incinerator destruction efficiency and determining energy usage. Results of the testing are summarized in this section.

The catalytic incinerator at Plant C-4 destroys solvents from the drying oven on a metal coating line. The coating line produces decorated metal sheets. The coatings used at Plant C-4 are purchased pre-mixed and contain a wide range of solvents. Some of the solvents were identified as MIBK, toluene, ethyl benzene, xylene and cellosolve.

The incinerator tested at Plant C-4 handles an inlet solvent laden air (SLA) flowrate of approximately 3.7 $m^3/s$ at 164°C (7940 acfm at 327°F). The incinerator catalyst bed is composed of catalyst coated ceramic honeycombs and is typically operated at an inlet temperature of 335°C (635°F). The catalyst had been in service for approximately 11 months at the time of testing.

During the one-week test period at Plant C-4, incinerator performance was characterized for two different coatings and three catalyst inlet temperatures. Inlet and outlet solvent concentrations were monitored with total hydrocarbon (THC) analyzers and gas chromatographs (GC). The results of the THC sampling are summarized in Tables 2-1 and 2-2.

The results shown in Table 2-1 indicate that incinerator destruction efficiency during normal process operation varied over a fairly wide range,

TABLE 2-1. SUMMARIZED THC SAMPLING RESULTS[a]

| Product | Range of Inlet THC Concentrations (ppmv-C)[b] | Range of Outlet THC Concentrations (ppmv-C)[b] | Range of Destruction Efficiencies (%) | Range of Catalyst Inlet Temperatures (°C (°F)) |
|---|---|---|---|---|
| A | 6,822 - 7,562 | 385 - 408 | 93.8 - 94.0 | 318 (605) |
| B | 4,198 - 6,546 | 363 - 687 | 86.1 - 92.4 | 332-393 (630-740) |

[a]Data presented in this table are for normal process operating periods only.

[b]ppmv-C = parts per million by volume as carbon, quanitated against propane. Concentration ranges are for average values measured at inlet or outlet of incinerator during different monitoring periods on the product noted.

TABLE 2-2. SUMMARY OF RESULTS FOR DIFFERENT CATALYST INLET TEMPERATURES[a]

| Product | Catalyst Bed Inlet Temperature (°C (°F)) | Inlet THC Concentration (ppmv-C)[b] | Outlet THC Concentration (ppmv-C)[b] | Destruction Efficiency (%)[c] |
|---|---|---|---|---|
| A | 318 (605) | 7,279 | 399 | 93.9 |
| B | 335 (635) | 5,949 | 610 | 88.7 |
| B | 368 (695) | 6,060 | 495 | 91.0 |
| B | 391 (735) | 5,275 | 363 | 92.4 |

[a]Data presented in this table are for normal process operating periods only.

[b]ppmv-C = parts per million by volume as carbon. Concentrations are average values measured at inlet or outlet of incinerator for all periods during which the incinerator operated at the indicated catalyst inlet temperature.

[c]Average of all test results at the indicated catalyst inlet temperature.

from 86.1 to 94.0 percent. As shown in Table 2-2, the catalyst inlet temperature was a major factor affecting incinerator efficiency.

The average natural gas energy usage for the incinerator was approximately $2.3 \times 10^9$ J/hr ($2.2 \times 10^6$ Btu/hr).

# SECTION 3

# PROCESS DESCRIPTION

Plant C-4 is a manufacturer of decorative metal cans and falls under SIC 3411, the metal can industry. Cans are produced from metal sheets which are first undercoated and then printed with decorative emblems, names, and various writings. Coatings and pigments dispersed in solvents are applied to the metal sheets in thin coats. The solvents are driven off as the metal sheets pass through drying ovens. Oven exhaust containing the volatilized solvents is ducted to a catalytic incinerator for solvent destruction. Normal operating hours at Plant C-4 are 16 hours per day, 5 days per week.

A description of the incinerator tested at Plant C-4 and its relationship to the decorative metal can production process is given in Section 3.1. Instrumentation used to monitor and control the incinerator is described in Section 3.2.

## 3.1 CATALYTIC INCINERATION PROCESS

The incinerator at Plant C-4 is used to destroy solvent emissions from a single sheet metal coating line. Coated metal sheets pass through five oven zones in addition to one preheat zone. Volatilized solvents are drawn from the various oven zones by a large fan through a common duct to the incinerator. In addition, fugitive VOC emissions resulting from the roll-type coating applicator operation are captured by a hood and ducted to the incinerator.

Two types of undercoatings were applied to metal sheets of various sizes during the test period. The undercoatings are applied to protect the

metal sheets and to allow printing. No printing is performed on the coating line tested. Coatings used at Plant C-4 are purchased pre-mixed from coating manufacturers and are of unknown composition. Major solvents identified by gas chromatography and mass spectrometry include methyl isobutyl ketone (MIBK), cellosolve, xylenes, ethyl benzenes and isophorone. Solids contents of the two coatings tested were 33 and 31.5 percent by weight.

A schematic diagram illustrating the relationship between the drying oven and incinerator is given in Figure 3-1. As shown in Figure 3-1, solvent laden air (SLA) drawn from the oven by a large blower passes through the burner zone of the incinerator. The SLA is heated by the combustion of natural gas and then passes through the catalyst bed where solvents in the SLA are oxidized. All of the incinerator outlet gas exhausts to the atmosphere through a single stack.

The actual gas flowrate through the incinerator is relatively constant for different products. However, the inlet solvent mass flowrate and the solvent type varies by product according to the coating type, sheet size and production rate.

The incinerator at Plant C-4 is a Maxom fume burner retrofitted with a DuPont Torvex$^{R}$ honeycomb catalyst bed. The incinerator has a design destruction efficiency of 90 percent and contains twelve, 12 in. x 10 in. x 12 in. catalyst modules. The total catalyst volume is 0.28 $m^3$ (10 $ft^3$). For this catalyst volume and a 60 percent void fraction, the residence time of the SLA in the catalyst bed is approximately 0.03 second. The total surface area of catalyst is approximately 249 $m^2$ (2,680 $ft^2$).[1]

The incinerator handles a SLA flowrate of approximately 3.7 $m^3/s$ at 164°C (7,940 acfm at 327°F). Based on measured THC concentrations, the inlet solvent mass flowrate ranged from 11 to 34 kg/hr (25 to 75 lb/hr), depending on the product type and size. Accounting for variations in

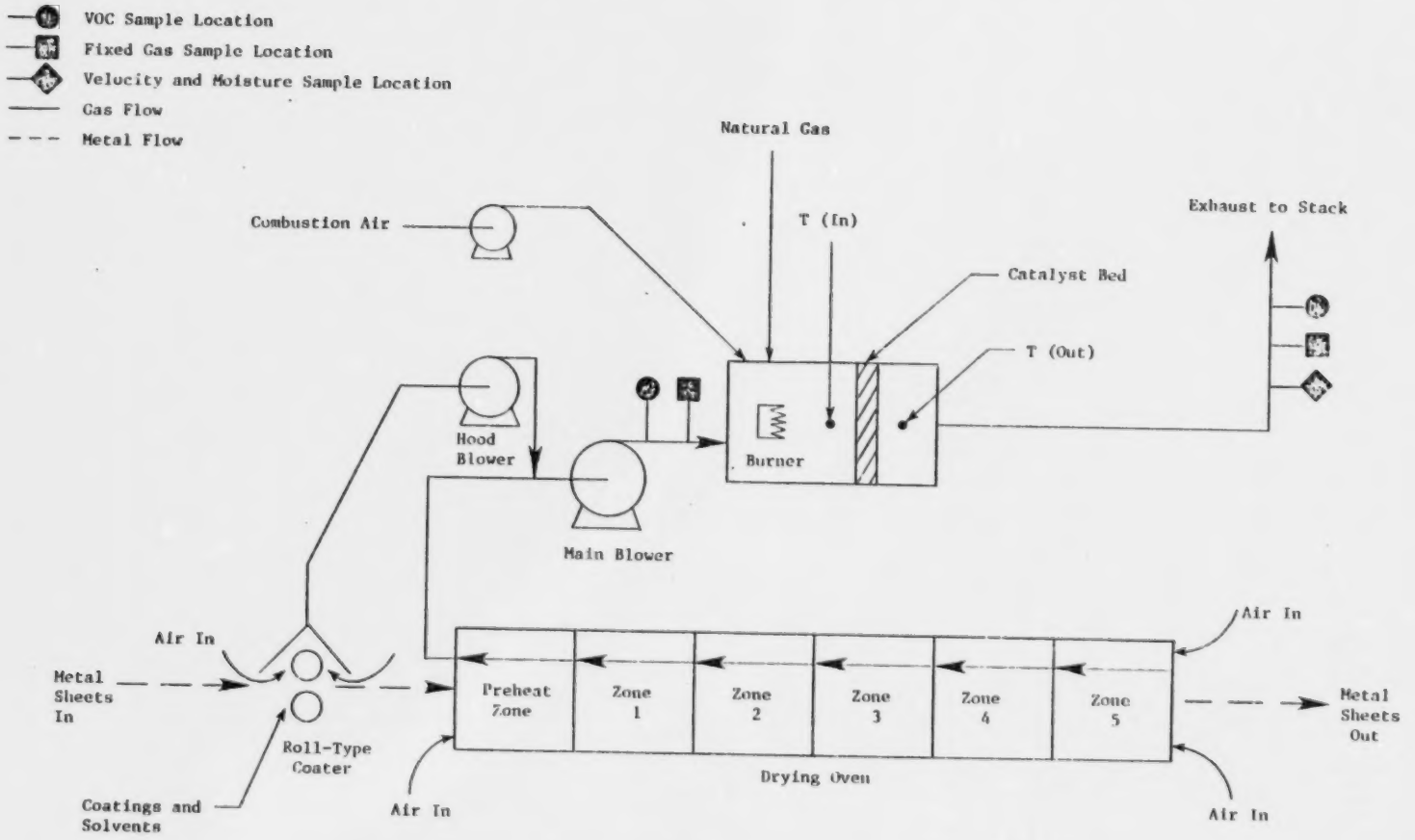


Figure 3-1. Process flow diagram for Plant C-4 incinerator.

product size, the average measured inlet solvent mass flowrates on a per unit surface area basis are 6.59 $g/m^2$ ($1.33 \times 10^{-3}$ $lb/ft^2$) and 7.40 $g/m^2$ ($1.51 \times 10^{-3}$ $lb/ft^2$), respectively, for the two coating types.

The incinerator tested at Plant C-4 was retrofitted with a catalyst bed in March 1982. This original catalyst was in place at the time of testing. However, in September 1982, the catalyst was temporarily removed from the incinerator and cleaned with an alkaline solution. This cleaning was required because the catalyst had become masked from operation at lower than optimum catalyst inlet temperatures. Since then, the incinerator has been operated at a minimum catalyst inlet temperature of 316°C (600°F) to prevent further catalyst masking.

## 3.2 INSTRUMENTATION AND CONTROLS

Instrumentation and controls associated with the incinerator at Plant C-4 include:

- temperature indicators showing catalyst inlet and outlet temperatures;
- a magnehelic gauge indicating pressure drop across the catalyst bed;
- a catalyst inlet temperature controller to maintain a minimum catalyst inlet temperature of 316°C (600°F); and
- an alarm to indicate catalyst temperature excursions above 538°C (1,000°F).

## SECTION 3 REFERENCES

1. Du Pont Torvex$^{R}$ Ceramic Honeycomb Data Sheet. E.I. Du Pont de Nemours & Co., Wilminton, Delaware. May 1981.

SECTION 4

# SAMPLING AND ANALYTICAL PROCEDURES

Testing procedures followed during the performance evaluation of the catalytic incinerator operated by Plant C-4 are presented in this section. Sampling procedures are discussed in Section 4.1 and analytical procedures are discussed in Section 4.2. Quality assurance/quality control procedures and results for Plant C-4 are discussed in the Quality Assurance Project Plan and Quality Assurance Report (Volume 9) for this program.

## 4.1 SAMPLING PROCEDURES

This section describes the sampling methodology Radian used to characterize the operation and determine the destruction efficiency of the Plant C-4 incinerator. EPA reference methods were typically used, however, some non-reference methods or modifications of reference methods were needed. The modifications are discussed in this section. A sampling procedure matrix is presented in Table 4-1.

### 4.1.1 Sample Acquisition for Volatile Organic Compounds and Carbon Dioxide

Both the incinerator inlet and outlet gas streams were continuously sampled throughout the test. A three-hole sampling rake was used to extract the gas sample from the main gas stream. As required by Method 25A specifications, the sampling rake had holes 3.2 mm (1/8 in) in diameter drilled in the tubing at a relative location of 16.7, 50 and 83.3 percent of the equivalent duct diameter. Sample gas passed through 1.8 m (6 ft.) of heat-traced stainless steel line and a heated (205°C, 400°F) sampling pump before entering a heat-traced Teflon$^{R}$ umbilical that carried it to the mobile laboratory. During transport through the umbilical from the duct to the laboratory, the sample gas was maintained at 100°C (212°F).

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TABLE 4-1. SAMPLING PROCEDURES MATRIX

| Parameter | Procedure |
|---|---|
| Fixed Gases and Volatile Organic Carbon (VOC) Content | EPA Method 25A |
| Gas Sample for GC/MS Analysis | Evacuated canister equipped with vacuum flow regulator |
| Moisture | EPA Method 4 |
| Velocity/Volumetric Flow Rate | EPA Methods 1 and 2 |
| Temperature | Thermocouple |
| Duct Pressure | Magnehelic® gauge or manometer |
| Other Process Data | Plant monitors or O&M records |

A manifold system inside the mobile laboratory was used to split the sample streams for analysis to two types of instruments, an organic species analyzer and a THC analyzer. After the heated gas passed through these instruments, it entered a set of impingers to knock out moisture and heavy organics. The cooled dry gas then proceeded through the Fisher Gas Analyzer before being vented. A schematic of this sampling arrangement is shown in Figure 4-1.

### 4.1.2 Acquisition of Organic Species for GC/MS Analysis

Samples for GC/MS analysis were acquired at the outlet of the sample acquisition system using evacuated canisters. The canisters were cleaned, evacuated, and the absolute pressure recorded before sampling. Immediately prior to sampling, canister pressure was remeasured to ensure that no leakage had occurred. Flow regulators were used to provide a constant flow over the 20-minute sampling period. The flow regulators and canisters were attached to the sample acquisition system between the last impinger (with silica gel) and next to last impinger (empty).

After sample collection was completed, the canister input valves were closed and the canisters were disconnected from the sample line. Then absolute canister pressure was again measured. Prior to shipment, all canister valves were tightened and stem nuts sealed with Swagelok$^{R}$ plugs. When received at Radian's laboratory, canister pressure was remeasured to ensure no leakage had occurred. The canisters were then pressurized with UHP $N_2$ to 10-15 psig to provide pressure for removing the sample.

### 4.1.3 Moisture Determination

The moisture content of the incinerator exhaust stream was determined using the methodology prescribed in EPA Method 4. Based on this method, a measured volume of particulate-free gas is pulled through a chilled impinger train. The quantity of water condensed in the impingers is determined

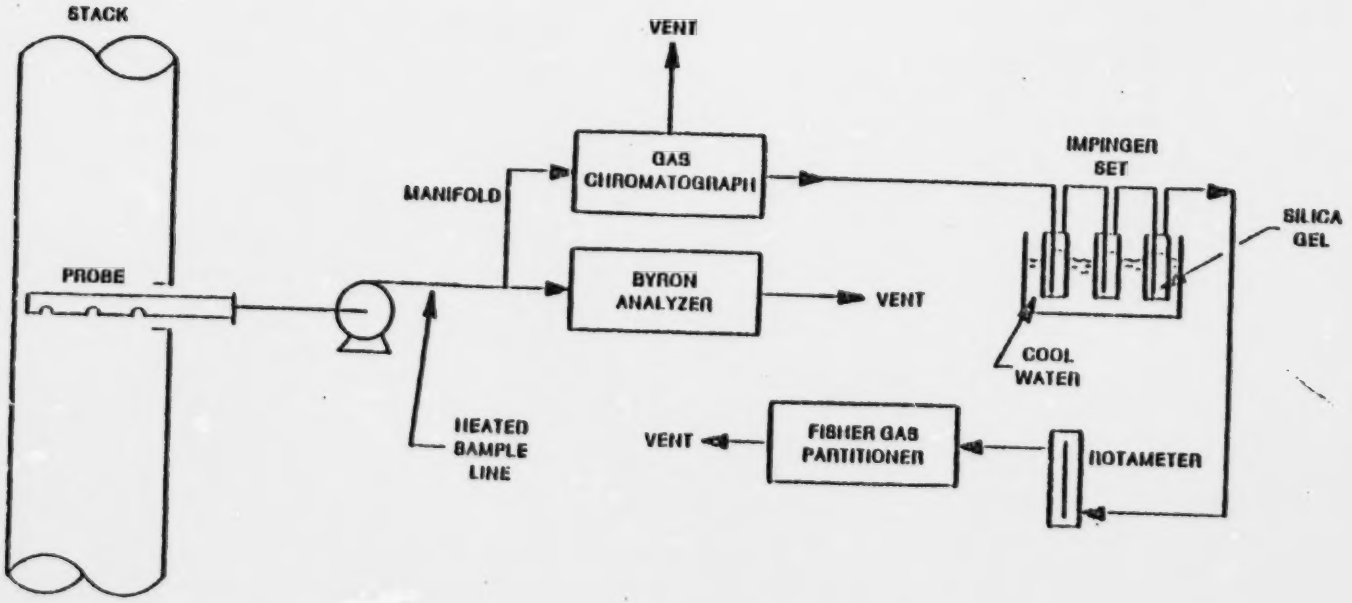


Figure 4-1. Positive pressure gas sampling system.

gravimetrically and then related to the volume of gas sampled to determine the moisture content. Figure 4-2 graphically illustrates the sampling train which is used for moisture determination.

### 4.1.4 Volumetric Gas Flow Rate Determination

The volumetric gas flow rate of the incinerator exhaust was measured using procedures described in EPA Method 2. As prescribed by this method, the volumetric gas flow rate was determined by measuring the cross-sectional area of the duct or stack and the average velocity of the flue gas. The average gas velocity was calculated from the average gas velocity pressure ($\Delta P$), the average flue gas temperature, wet molecular weight, and the absolute pressure in the stack. Temperature and $\Delta P$ profiles were obtained by traversing the stack.

Temperature profile and $\Delta P$ data were collected at each of the sampling points using a K-type thermocouple and an S-type pitot tube. A gauge oil manometer was used to measure the pressure drop ($\Delta P$) across the S-type pitot. The daily barometric pressure was obtained from a local weather station and corrected for elevation. The static gas pressure at the incinerator inlet and outlet was measured by disconnecting one side of the S-type pitot and rotating it so it was perpendicular to the gas flow. A gauge oil manometer was used to measure the static pressure at this point in the duct.

The volumetric gas flowrate at the incinerator inlet could not be measured according to EPA Method 2 because no acceptable sampling location was available. The inlet flowrate was calculated from the measured outlet flowrate and estimated combustion air and natural gas flowrates. The estimating procedures are discussed further in Section 5.1.

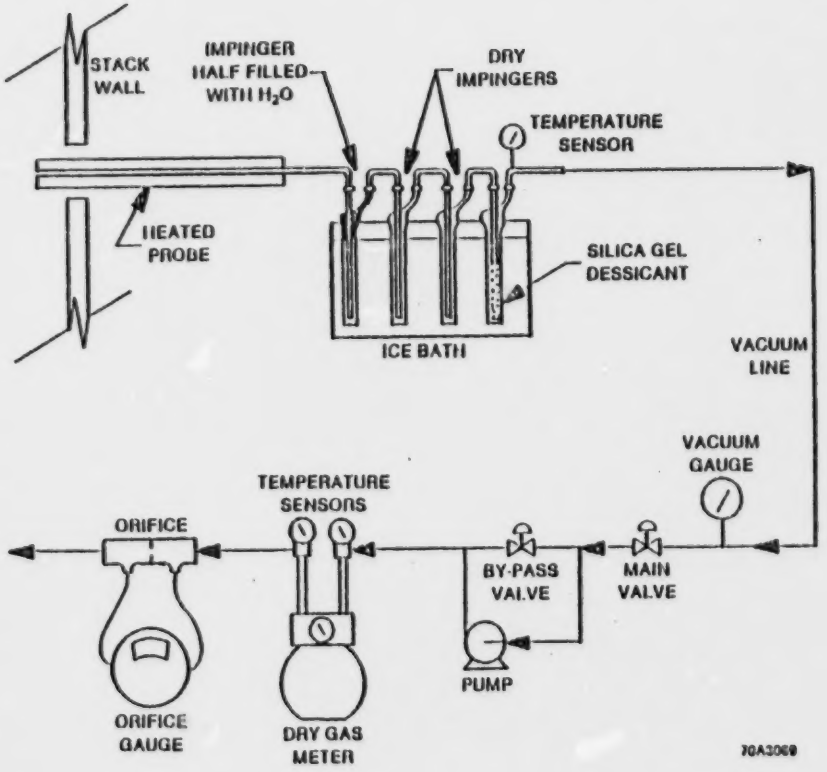


Figure 4-2. EPA Method 4 moisture train.

### 4.1.5 Process Data

In addition to VOC concentrations, stream molecular weights and volumetric flow rates, several process parameters were determined or obtained at various points in the incinerator. These parameters included pressure drops across each stage of the system, intermediate temperatures, and combustion air and fuel parameters. These additional parameters and the methods which were used for their quantitation are presented in Table 4-2. In many instances, these data were obtained from the plant.

## 4.2 ANALYTICAL PROCEDURES

This section details the analytical methodology Radian used to characterize operational conditions and to measure the VOC destruction efficiency of the Plant C-4 incinerator. EPA reference methods were used where applicable. Any non-reference method or modifications of reference methods are discussed in this section. An analytical methods matrix is presented in Table 4-3.

### 4.2.1 Determination of VOC Concentrations

On-site VOC determinations were accomplished using two methods, EPA Method 25A and the draft Method 18. The first method uses flame ionization detection (FID) to provide total hydrocarbon (THC) concentrations. Similarly, the second method also uses an FID for quantification; however, the various organic species in the gas sample are chromatographically speciated prior to detection.

#### 4.2.1.1 EPA Method 25A--

Method 25A specifies that THC determinations be performed using a continuous monitor equipped with an FID. Although an FID was used on this project, monitoring was performed on a semi-continuous basis using two Byron THC analyzers, one connected to the incinerator inlet sampling manifold and one to the outlet.

TABLE 4-2. ADDITIONAL INCINERATOR PROCESS PARAMETERS FOR PERFORMANCE EVALUATION

| Stream | Parameter | Test Method |
|---|---|---|
| Incinerator Auxiliary Fuel | Type | Plant Data |
| | Composition | Plant Data |
| | Heating Value | Plant Data |
| | Rate | Plant Data |
| Combustion Air | Rate | Plant Data |
| Exhaust Gas or Stack Incinerator | Velocity Profile | EPA Methods 1, 2, 3[a] and 4 |
| | Temperature Profile | |
| Heat Recovery Data | Inlet/Outlet Temperatures | Thermocouple |

[a]Fisher Gas Partitioner, Model 1200, was used as an equivalent method of determining molecular weight.

TABLE 4-3. ANALYTICAL PROCEDURES MATRIX

| Parameter to be Measured | Method |
|---|---|
| VOC Concentration | EPA Method 25A<br>Draft EPA Method 18<br>GC/MS Analysis |
| Fixed Gases (Molecular Weight) | Gas Chromatography (Thermal Conductivity Detection) |
| Moisture | EPA Method 4 |
| Velocity/Volumetric Flow Rate[a] | EPA Methods 1 and 2 |
| Temperature[a] | Thermocouple |
| Pressure[a] | Magnehelic® Gauge or Manometer |
| Other Process Data[a] | Plant Monitors or O&M Records |

[a]Discussed in detail in Sections 4.1.4 and 4.1.5.

A Byron 301 THC analyzer was used to measure inlet THC concentrations. The Byron Model 301 Hydrocarbon Analyzer is a non-specific process gas chromatograph (GC) utilizing a flame ionization detector (FID) system to quantitatively determine methane ($CH_4$) and non-methane hydrocarbons in the vapor phase. Zero grade air and hydrogen are used for the flame while zero grade air is the GC column carrier gas. The analyzer contains sufficient hardware to provide sample valve and column valve switching at pre-set times. The instrument used for this testing was set to take a sample every three minutes.

At the beginning of a cycle, an internal contact closure allows the pressure in the sample loop to equilibrate to atmospheric pressure. Twelve seconds into the cycle, the sample inject valve actuates. Gas in the sample loop is swept into a stripper column where $CH_4$ is separated from other organic compounds. After the $CH_4$ elutes from the column and passes through the detector, the non-methane hydrocarbons (NMHC) are backflushed out of the column and through the detector. Figure 4-3 is a schematic flow diagram of the Byron 301 instrument which shows the sample path through the instrument.

The electronics in the instrument provide fixed time peak detection windows, auto zeroing and peak integration capabilities. For six seconds after each peak window opens, the detector signal is monitored and auto zeroing occurs. During the remainder of each peak window, the detector signal is amplified and passed to a storage capacitor to accumulate the total charge from the detector. The amplified signal is continuously monitored with a strip chart recorder. At the end of the peak window, a signal representing the integrated area of the peak (the accumulated charge) is transferred to a capacitor. This charge is used as the input to a computer data acquisition system and remains there until completion of the peak window for the next cycle.

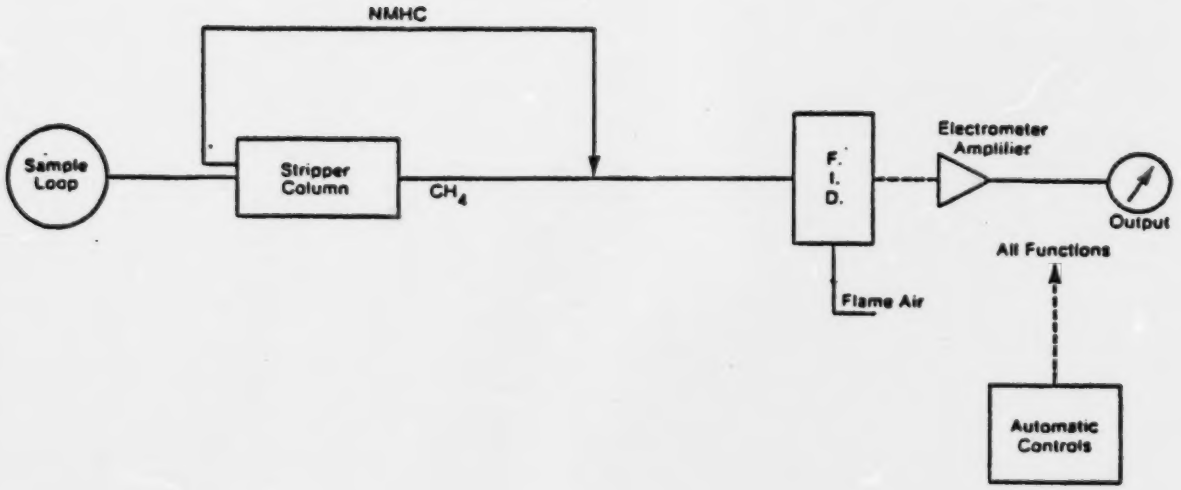


Figure 4-3. Schematic diagram of Byron 301 sample path.

Panel controls on the Byron 301 allow for a VOC range selection of 2 to 20,000 ppm, amplifier gain settings over a wide range, and detector zeroing. The gain setting potentiometers allow calibration of the instrument to provide any specified area value for the standard. For example, a 100 ppm standard can be analyzed to yield an integrated area corresponding to a 100 percent of the full-scale attenuation. In this case, calibration represents a convenient way to determine accurate hydrocarbon concentrations over the full-scale range, i.e., an area of 100 would represent 100 ppm, an area of 50 would represent 50 ppm, and so on.

A Byron 401 was used to measure THC and carbon monoxide (CO) in the incinerator outlet stream. The Byron Model 401 Total Emissions Analyzer is similar in many respects to the model 301 described in the above section. The 401 has the additional capability of analyzing a sample stream for total hydrocarbons (THC), nonmethane hydrocarbons, carbon dioxide ($CO_2$), methane, and carbon monoxide (CO). The instrument was operated mostly in the THC mode because the one minute cycle time allowed measurement of relatively rapid concentration changes. The full scan mode was operated for brief periods to obtain measurements of CO and $CH_4$ in the outlet gas.

At the beginning of a THC cycle, contact closure occurs to allow the sample loop to equilibrate to atmospheric pressure. After 12 seconds, a sample is injected and flows directly into the FID. Electronic measurement of this peak and its area proceeds as described above for the Byron 301. The cycle repeats after one minute. Figure 4-4 is a schematic flow diagram of the Byron 401 that indicates the sample path through the instrument. Both the THC sample mode and the full scan mode are shown.

In the full scan mode, the cycle time is 12 minutes. The gas sample introduced into the 401 is ultimately separated into five groups of compounds:

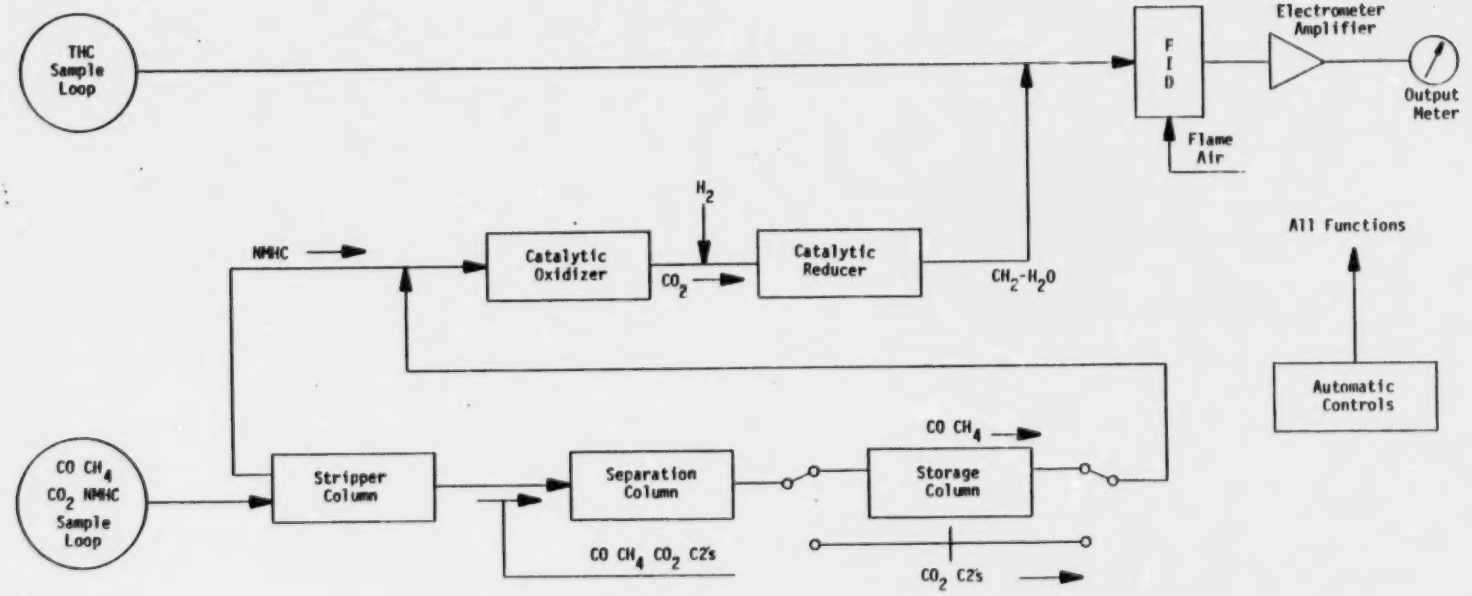


Figure 4-4. Schematic Diagram of Byron 401 Sample Path.

- total hydrocarbons,
- $C_3$+ hydrocarbons,
- carbon monoxide (CO) and methane ($CH_4$),
- carbon dioxide ($CO_2$), and
- the $C_2$ hydrocarbon group.

In operation the full scan cycle proceeds by first stripping the $C_3$+ group out of the sample contained in the sample loop. This is done using a chromatographic column which retains $C_3$+ compounds while allowing the remainder to pass through to a separation column. Meanwhile, the separation column separates the balance of the sample into the remaining three groups. CO and $CH_4$ emerging from the separator are retained on a 5A molecular sieve storage column while the $CO_2$ and $C_2$ groups are eluted. CO and $CH_4$ are then resolved and follow the same path to the FID where they are measured separately as $CH_4$.

All data from the Byron instruments were automatically recorded, stored on disk, and reduced using an Apple$^R$ II minicomputer. The computer also recorded the date and time of analysis, instrument, and sampling location. As a backup to the minicomputer data acquisition system, integrated areas of the peaks generated by each instrument were recorded using a strip chart recorder.

4.2.1.2 Method 18--

The draft Method 18 differs from Method 25A in that sample acquisition may be performed either by direct interface or by grab sampling. In addition, the organic species content in the stream is chromatographically speciated prior to detection by FID.

The draft Method 18 provides for the individual quantitation of organic species by gas chromatography using a flame ionization detector (FID). These analyses were performed on the same sample gas used for Method 25A. Analyses were performed simultaneously with the Method 25A analyses whenever

possible. The gas sample was introduced into a fixed volume sample loop on an oven-mounted, 10-port stainless steel valve. After the loop was flushed with at least a 100-fold volume of sample, the gas flow was stopped and the loop was allowed to come to atmospheric pressure. The valve was then switched to the inject position. The instrument and analytical conditions used were:

- Instrument: Tracor Model 560
- Column: 6 ft. x 1/8 od s.s., Carbopack BHT 50/80 mesh
- Carrier Gas: Nitrogen at 30 mL/min
- Temperature Program: 120°C for 2 min, 20°C/min to 250°C, 250°C until elution was complete
- Injection: 5 mL fixed volume loop
- Detector: 300°C

4.2.1.3 GC-MS Method--

Organic species were identified by GC/MS analysis of 20-minute, integrated samples taken in evacuated canisters. This system allows the identification of low molecular weight organics in the inlet and exhaust streams. The GC/MS uses a cryogenic trap to isolate sample components. The analytical conditions are summarized in Table 4-4. The cryogenic trapping system which was used is microprocessor controlled with air actuated valves to maximize analytical reproducibility.

4.2.2 Determination of Fixed Gases (Molecular Weight)

The dry ($M_d$) and wet ($M_w$) molecular weight of the incinerator inlet and exhaust streams were determined by a modified version of EPA Method 3. Rather than collecting integrated or grab samples of the gas stream, the umbilical and manifold system described in Section 4.1.1 was used to acquire samples for fixed gas ($CO_2$, $O_2$, and $N_2$) analyses.

TABLE 4-4. GC-MS CONDITIONS FOR ANALYSIS OF CANISTER SAMPLES

| | |
|---|---|
| **GC-MS Conditions** | |
| Instrument | Hewlett-Packard Model 5982 |
| Ionization voltage | 70 eV |
| Scan rate | 1 scan/sec |
| Scan range | 10-200 amu |
| Column | 25 meter DB-5 Fused Silica wide bore thick film |
| Initial temperature | -50°C |
| Program rate | 16°C/min |
| Final temperature | 280°C |
| Interface | Open split coupled |
| **Trap Conditions** | |
| Cryogenic trap temperature | -183°C |
| Desorption temperature | 190°C |
| Desorption time | >10 min |

A Fisher Model 1200 Gas Partitioner was used for fixed gas analysis. This instrument employed a 0.25 ml sample loop, dual columns and dual thermal conductivity (TC) detectors. When the gas sample was introduced from the loop, it was first carried into Column 1. This column held up $CO_2$ while the rest of the sample passed quickly through the column to the first TC detector producing a composite peak. The $CO_2$ then eluted from Column 1 and was detected by the first TC detector. This peak was used for $CO_2$ quantitation. The early eluting composite and the $CO_2$ then passed into Column 2 where the $CO_2$ fraction was permanently adsorbed while the remaining portion of the original sample was chromatographically separated into its components. These separated components eluted from Column 2 to be individually detected by the second TC detector. The operating parameters for the analysis were:

- Column 1: 1/8" x 6.5' aluminum packed with 80-100 mesh Columnpak PQ.
- Column 2: 3/16" x 11" aluminum packed with 60-80 mesh Molecular Sieve 13x.
- Oven temperature: 50°C
- Bridge Current: 225 mA
- Carrier Gas: 8.5% $H_2$ in He at 30 cc/min.

The dry molecular weight of the inlet/exhaust gas was calculated based on the concentrations of the fixed gases and converted to a wet basis using the Method 4 moisture data.

### 4.2.3 Determination of Moisture Content

The moisture content of the incinerator inlet and exhaust streams was determined using the methodology described in EPA Method 4. By this method, a measured volume of particulate-free gas is pulled through a chilled impinger train. The quantity of water condensed in the impingers is determined gravimetrically and then related to the volume of gas sampled to determine the moisture content.

## REFERENCES


1. EPA Proposed Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," Proposed Revision to Appendix A 40 CFR, Federal Register, Volume 45, Number 194, December 17, 1980. pp. 83149-83151.

2. EPA Draft Method 18, "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography," Personal communication with Jeff Chappell, U.S. Environmental Protection Agency, IERL-RTP.

3. EPA Reference Method 3, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight," Appendix A to 40 CFR, Environmental Reporter, Bureau of National Affairs, Washington, D.C., December 5, 1980. pp. 33-36.

4. EPA Reference Method 4, "Determination of Moisture Content in Stack Gases," Appendix A to 40 CFR, Environmental Reporter, Bureau of National Affairs, Washington, D.C., December 5, 1980. pp. 36-41.

5. EPA Reference Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube), Appendix A to 40 CFR, Environmental Reporter, Bureau of National Affairs, Washington, D.C., December 5, 1980. pp. 25-33.

# SECTION 5

# RESULTS OF TESTING AND ANALYSIS

The catalytic incinerator at Plant C-4 was tested from January 31 through February 5, 1983. Data collected during the test period indicated destruction efficiencies ranging from 86 to 94 percent. These efficiencies result from data collected for two product types of varying sizes and three operating temperatures.

The results of the testing conducted at Plant C-4 are presented in this section. Operating parameters and VOC sampling results are discussed in Sections 5.1 and 5.2, respectively. Included in Section 5.2 is a parametric analysis of incinerator performance at Plant C-4.

## 5.1 OPERATING PARAMETERS

The operating conditions and parameters measured or recorded during testing at Plant C-4 are summarized in Table 5-1. These data include gas temperature, inlet solvent laden air (SLA) and stack gas flowrates, stack gas moisture contents, and energy consumption.

The inlet SLA temperature and the catalyst inlet and outlet temperatures were continuously monitored and recorded using Type K thermocouples and a multipoint strip chart temperature recorder. No acceptable sampling location was available for direct measurement of the incinerator inlet SLA flowrate. The inlet flowrate was estimated by subtracting estimated fuel gas and combustion air flowrates from the stack gas flowrate. The stack gas flowrate was measured by EPA Method 2 and the stack gas moisture content was measured using EPA Method 4.

TABLE 5-1. SUMMARY OF OPERATING PARAMETERS AT PLANT C-4

| Parameter | Average Value | Range |
|---|---|---|
| Catalyst inlet temperature[a] | 346°C (655°F) | 318 - 393°C (605 - 740°F)[b] |
| Catalyst outlet temperature[a] | 407°C (764°F) | 354 - 460°C (670 - 860°F)[b] |
| Inlet SLA flowrate[c] | 2.52 $Nm^3/s$ (5,330 scfm) | - |
| Inlet SLA temperature[a] | 164°C (327°F) | 107 - 182°C (225 - 360°F) |
| Inlet SLA static pressure[d] | 0.60 kPa (2.4 in. $H_2O$) | - |
| Combustion air flowrate[e] | 0.24 $Nm^3/s$ (514 scfm) | - |
| Stack gas flowrate (dry)[f] | 2.62 $dNm^3/s$ (5,550 dscfm) | 2.39 - 2.88 $dNm^3/s$ (5,056 - 6,100 dscfm) |
| Stack gas flowrate (wet)[f] | 2.77 $Nm^3/s$ (5,880 scfm) | 2.53 - 3.05 $Nm^3/s$ (5,350 - 6,460 scfm) |
| Stack gas temperature[f] | 199°C (390°F) | 172 - 224°C (342 - 436°F) |
| Stack gas moisture content[f] | 5.4% | 5.1 - 5.5% |
| Catalyst bed pressure drop[d] | 0.42 kPa (1.7 in. $H_2O$) | - |
| Burner pressure drop[d] | 0.10 kPa (0.4 in. $H_2O$) | - |
| Natural gas usage[g] | 0.017 $m^3/s$ (36 cfm) | 0.014 - 0.020 $m^3/s$ (30 - 42 scfm) |
| Natural gas energy usage[h] | $2.3 \times 10^9$ J/hr ($2.2 \times 10^6$ Btu/hr) | $1.9 \times 10^9$ - $2.7 \times 10^9$ J/hr ($1.8 \times 10^6$ - $2.6 \times 10^6$ Btu/hr) |
| Fan energy usage[i] | 7.2 kW | - |

[a] From thermocouple measurements.

[b] This temperature was varied intentionally over this range to characterize incinerator performance.

[c] Estimated from outlet gas, fuel gas, and combustion air flowrates.

[d] Measured by Magnehelic® gauge.

[e] Based on combustion air fan design flowrate.

[f] For roof stack venting to atmosphere. Volumetric flowrate and moisture content results are summarized in Appendix B; molecular weight determination is presented in Appendix E.

[g] Based on natural gas energy requirements and heating value of 1,022 Btu/scf.

[h] Estimated from the average change in enthalpy of the SLA through the incinerator burner.

[i] Total for main blower and hood fan; based on ammeter measurements.

The total energy used by the main blower and the hood blower was determined by ammeter measurements. The natural gas energy requirement for the incinerator was estimated from the average change in enthalpy ($\Delta H$) of the SLA as it passes through the incinerator burner. Tabulated enthalpy values for combustion gases at the appropriate burner inlet and catalyst inlet temperatures were used in the calculations.[1] Natural gas consumption by the incinerator was determined from the estimated natural gas requirement and a natural gas heating value of 38,100 kJ/$Nm^3$ (1,022 Btu/scf).

Figure 5-1 illustrates the effect of operating temperature on natural gas consumption. As indicated in Figure 5-1, natural gas usage increases with increased catalyst operating temperature.

Two types of coatings were applied to metal sheets of varying sizes during testing of the incinerator at Plant C-4. Products made with the two coating types are identified in this report as Products A and B. Table 5-2 presents the product types and sizes for the test periods during which data were collected under normal process operation.

Process shutdowns and start-ups at Plant C-4 generally occurred for one of three reasons: employee lunch breaks, shift changes, and product changeovers. Process shutdowns for employee lunch breaks and shift changes last about 30 minutes, while process shutdowns for product changeover range from 10 minutes to over 2 hours. Data obtained during process shutdowns were not included in Table 5-2.

During normal working periods, the coating line was operated continuously. Stacks of metal sheets were fed through the coaters in batches. A short break of 2 to 4 minutes occurred between batches while the next stack of metal was set up. The production rate of the coating line ranged from 68 to 83 sheets per minute.

TABLE 5-2. PRODUCTS MADE DURING VOC SAMPLING AT PLANT C-4

| Date | Monitoring Period | Length of Monitoring Period (min.) | Product ID | Product Size (in.) |
|---|---|---|---|---|
| 1/31/83 | 2139 - 2252 | 73 | A | 32 x 42 |
| 2/1/83 | 0727 - 0809 | 45 | A | 32 x 42 |
| 2/1/83 | 1929 - 2101 | 94 | A | 32 x 42 |
| 2/3/83 | 1300 - 1911 | 323 | B | 30 x 39 |
| 2/3/83 | 2051 - 2301 | 130 | B | 29 x 37 |
| 2/4/83 | 1017 - 1117 | 61 | B | 29 x 37 |
| 2/4/83 | 1210 - 1222 | 12 | B | 29 x 37 |
| 2/4/83 | 1440 - 1710 | 152 | B | 35 x 39 |
| 2/4/83 | 1824 - 2043 | 142 | B | 31 x 39 |
| 2/4/83 | 2044 - 2213 | 90 | B | 31 x 39 |
| 2/4/83 | 2217 - 2242 | 25 | B | 31 x 39 |
| 2/4/83 - 2/5/83 | 2259 - 0101 | 123 | B | 31 x 39 |
| 2/5/83 | 0102 - 0158 | 57 | B | 31 x 39 |
| 2/5/83 | 0159 - 0310 | 71 | B | 31 x 39 |
| 2/5/83 | 0319 - 0534 | 138 | B | 34 x 39 |
| 2/5/83 | 0608 - 1113 | 264 | B | 30 x 36 |

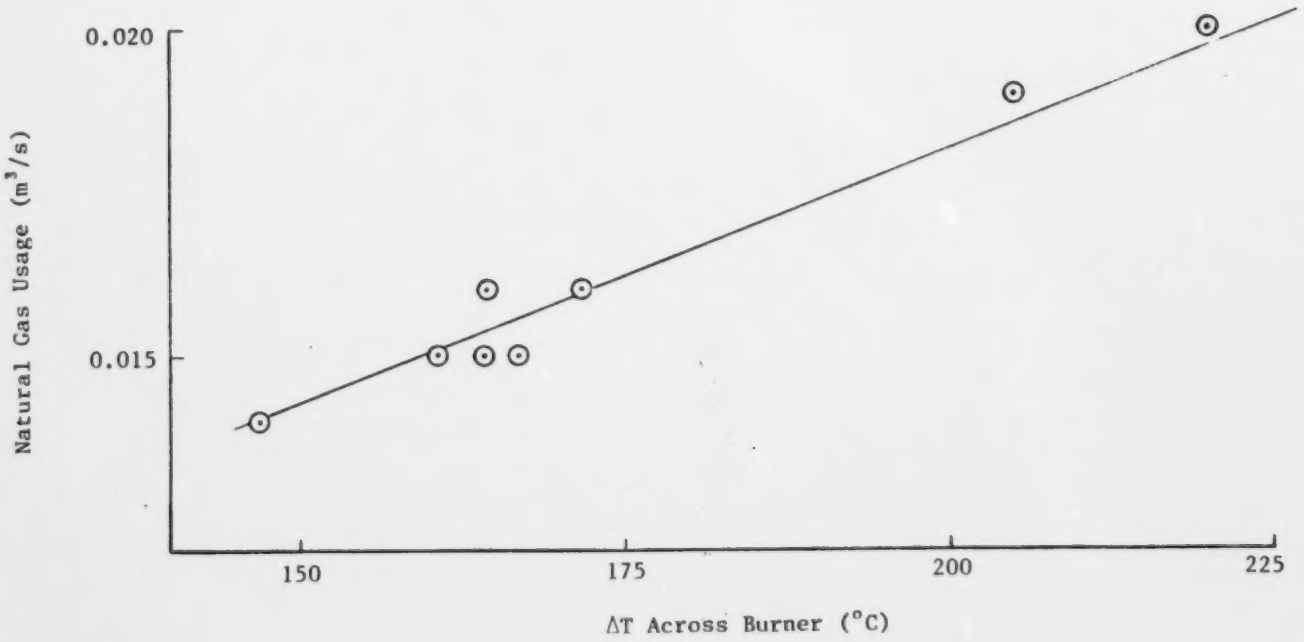


Figure 5-1. Effect of Incinerator Operating Temperature on Natural Gas Usage.

## 5.2 VOC SAMPLING RESULTS

The results of total hydrocarbon (THC) and gas chromatography analyses at Plant C-4 are presented in this section. Data were collected for two product types of varying sizes. Inlet THC concentrations varied according to production rate and product type and size. In addition, data were collected at three catalyst inlet temperatures. A total of more than 30 hours of data were collected during testing at Plant C-4.

The THC concentrations presented in this section are expressed in parts per million by volume as carbon (ppmv-C). Destruction efficiencies are based on incinerator inlet and outlet THC mass flowrates. The mass flowrates were calculated on the basis of measured THC concentrations and the average incinerator inlet and outlet gas flowrates. Gas flowrates used in the calculation are those presented in Section 5.1.

Section 5.2.1 presents an overview of the Method 25A sampling results for Plant C-4. In Section 5.2.2, the effects of various operating parameters on incinerator performance are discussed. Section 5.2.3 contains the results of Method 18 analyses.

### 5.2.1 Summary of Method 25A Results

The Method 25A (THC analysis) results for the incinerator at Plant C-4 are summarized in Table 5-3. Included in Table 5-3 are the measured average inlet and outlet THC concentrations and calculated destruction efficiencies for each monitoring period. Inlet and outlet THC concentration data from which these averages are calculated are given in Appendix A. The pertinent process data for each monitoring period are also given in Table 5-3. Periods during which the catalyst inlet temperature fluctuated or process operation was unsteady are noted.

TABLE 5-3. SUMMARY OF METHOD 25A SAMPLING RESULTS AT PLANT C-4

| Date | Monitoring Period | Length of Monitoring Period (min) | Product ID | Average Gas Temperature °C (°F) | | Inlet THC Concentration (ppmv-C)[a] | Outlet THC Concentration (ppmv-C)[a] | Average Destruction Efficiency[d] |
|---|---|---|---|---|---|---|---|---|
| | | | | Catalyst Inlet | Catalyst Outlet | | | |
| 1/31/83 | 2139 - 2252 | 73 | A | 318 (605) | 382 (720) | 7,562 | 408 | 94.0 |
| 2/1/83 | 0727 - 0809 | 45 | A | 318 (605) | 366 (690) | 6,822[b] | 385 | 93.8[b] |
| 2/1/83 | 1929 - 2101 | 94 | A | 335 (635) | 363 (685) | 2,545[c] | 251 | 88.8[c] |
| 2/3/83 | 1300 - 1911 | 323 | B | 335 (635) | 396 (745) | 5,998 | 601 | 88.9 |
| 2/3/83 | 2051 - 2301 | 130 | B | 335 (635) | 385 (725) | 5,484 | 564 | 88.7 |
| 2/4/83 | 1017 - 1117 | 61 | B | 332 (630) | 385 (725) | 4,725 | 546 | 87.3 |
| 2/4/83 | 1210 - 1222 | 12 | B | 335 (635) | 354 (670) | 4,198 | 530 | 86.1 |
| 2/4/83 | 1440 - 1710 | 152 | B | 368 (695) | 432 (810) | 6,060 | 495 | 91.0 |
| 2/4/83 | 1824 - 2043 | 142 | B | 363 (685) | 443 (830) | 6,546[b] | 531 | 91.0[b] |
| 2/4/83 | 2044 - 2213 | 90 | B | 377 (710) | 454 (850) | 6,403[b] | 445 | 92.3[b] |
| 2/4/83 | 2217 - 2242 | 25 | B | 393 (740) | 460 (860) | 6,435[b] | 440 | 92.4[b] |
| 2/4/83 - 2/5/83 | 2259 - 0101 | 123 | B | 391 (735) | 452 (845) | 5,275 | 363 | 92.4 |
| 2/5/83 | 0102 - 0158 | 57 | B | 371 (700) | 432 (810) | 5,526[b] | 500 | 90.0[b] |
| 2/5/83 | 0159 - 0310 | 71 | B | 335 (635) | 402 (755) | 5,618 | 592 | 88.4 |
| 2/5/83 | 0319 - 0534 | 138 | B | 335 (635) | 407 (765) | 6,418 | 687 | 88.2 |
| 2/5/83 | 0608 - 1113 | 264 | B | 332 (630) | 388 (730) | 4,714 | 501 | 88.3 |

[a] ppmv-C = parts per million by volume as carbon quanitated against propane.

[b] Unsteady catalyst inlet temperature.

[c] Unsteady process operation.

[d] Destruction Efficiency = $\frac{Min - Mout}{Min} \times 100\%$, where

$$M = \text{THC Mass Rate} = \frac{(V) \text{ moles C}}{10^6 \text{ moles gas}} \times \frac{12 \text{gC}}{\text{mole C}} \times \frac{\text{mole gas}}{0.024 \text{m}^3 \text{ gas}} \times \frac{(Q) \text{ m}^3 \text{ gas}}{\text{sec}}$$

V = THC concentration (inlet or outlet), ppmv

Q = gas glowrate (inlet or outlet), $Nm^3/sec$

During testing, destruction efficiencies measured for the incinerator ranged from 86.1 to 94.0 percent. The average destruction efficiency was 89.8 percent. As seen in Table 5-3, the destruction efficiency for Product A was generally greater than for Product B with the exception of one monitoring period (2/1/83: 1929-2101). Unsteady process operation during that period evidently resulted in a relatively low destruction efficiency of 88.8 percent as compared to higher efficiencies of 94.0 and 93.8 percent for the same product at different monitoring periods.

The higher destruction efficiency observed for Product A compared to Product B is probably due to a difference in solvent composition. The primary solvents in the Product A coating appeared to be ethyl benzene, xylene and another compound in the $C_7$+ range. For the Product B coating, the primary solvents were methyl isobutyl ketone (MIBK) and a $C_6$ compound identified as possibly either n-butyl acetate or 2-ethoxyethyl acetate (see Section 5.2.3).

Under normal conditions, the incinerator at Plant C-4 is operated at a catalyst inlet temperature of 335°C (635°F). During testing, data was collected at two additional catalyst inlet temperatures of 368°C (695°F) and 391°C (735°F).

Inlet THC concentrations ranging from 2,545 to 7,562 ppmv-C were measured during testing of the incinerator. The corresponding inlet THC mass flowrates ranged from 11.5 to 34.2 kg/hr (25.4 to 75.4 lb/hr). The average inlet THC concentration was 5,636 ppmv-C (25.5 kg/hr (56.2 lb/hr)).

Table 5-4 presents a summary of the average inlet THC mass flowrates for each product type and size. In order to account for variations in product size, Table 5-4 also gives average inlet mass flowrates on a unit product surface area basis. The inlet THC mass flowrate per product surface area was determined from the mass flowrate and the coating rate for each product. As seen in Table 5-4, the inlet THC mass flowrate increased as the

TABLE 5-4. SUMMARY OF INLET THC MASS FLOWRATES

| Date | Length of Monitoring Period (min) | Product ID | Product Size cm | Product Size (in.) | Coating Rate[a] $m^2$/hr | Coating Rate[a] ($ft^2$/hr) | Inlet THC Mass Flowrate[b] kg/hr | Inlet THC Mass Flowrate[b] (lb/hr) | Inlet THC Mass Flowrate Per Product Surface Area kg/$m^2$ | Inlet THC Mass Flowrate Per Product Surface Area (lb/$ft^2$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/31/83 - 2/1/83 | 212 | A | 81x107 | (32x42) | 3,640 | (39,200) | 24 | (52) | $6.59 \times 10^{-3}$ | $(1.33 \times 10^{-3})$ |
| 2/3/83 | 323 | B | 76x99 | (30x39) | 3,160 | (34,130) | 27 | (60) | $8.54 \times 10^{-3}$ | $(1.76 \times 10^{-3})$ |
| 2/3/83 - 2/4/83 | 203 | B | 74x94 | (29x37) | 2,920 | (31,300) | 24 | (52) | $8.22 \times 10^{-3}$ | $(1.66 \times 10^{-3})$ |
| 2/4/83 | 152 | B | 89x99 | (35x39) | 3,590 | (38,680) | 27 | (60) | $7.52 \times 10^{-3}$ | $(1.55 \times 10^{-3})$ |
| 2/4/83 - 2/5/83 | 508 | B | 79x99 | (31x39) | 3,890 | (41,810) | 27 | (59) | $6.94 \times 10^{-3}$ | $(1.41 \times 10^{-3})$ |
| 2/5/83 | 138 | B | 86x99 | (34x39) | 4,090 | (44,200) | 29 | (64) | $7.09 \times 10^{-5}$ | $(1.45 \times 10^{-3})$ |
| 2/5/83 | 264 | B | 76x91 | (30x36) | 3,320 | (36,000) | 21 | (47) | $6.33 \times 10^{-5}$ | $(1.31 \times 10^{-3})$ |

[a]Calculated from product sheet size and feed rate.

[b]Based on measured inlet THC concentrations (see Table 5-3).

product coating rate increased. However, the inlet THC mass flowrate per product surface area remained relatively constant for the same product type.

Outlet THC concentrations ranged from 251-687 ppmv-C. The corresponding range of mass flowrates was 1.25-3.42 kg/hr (2.76-7.55 lb/hr). The average outlet THC concentration was 511 ppmv-C.

The concentration of CO in the incinerator outlet gas was also measured for the Plant C-4 incinerator. Outlet CO concentrations ranged from 22-63 ppmv. The average CO concentration during testing was 30 ppmv.

### 5.2.2 Parametric Analysis of Incinerator Performance

The effect of various operating parameters on incinerator performance are discussed in this section. The following parametric relationships are considered:

(1) effect of catalyst bed inlet temperature on incinerator destruction efficiency;

(2) effect of inlet THC concentration on destruction efficiency; and

(3) relationship between mass of solvent destroyed and temperature rise across the catalyst bed.

In each case, the analysis includes only test results that are representative of normal process operation.

A statistical validation of the first parametric analysis has been performed to verify that the functional relationship observed is not a result of measurement data variability (i.e., random error). The results of the validation are presented in the quality assurance report for this

program.[2] The conclusions presented in this section regarding the effect of temperature on destruction efficiency were found to be statistically valid at a confidence level of 95 percent.

The effect of catalyst bed inlet temperature on incinerator efficiency is shown in Table 5-5. Table 5-5 gives the average destruction efficiency for the three catalyst inlet temperature settings used during testing at Plant C-4. Only data with approximately the same inlet THC concentration were included in this analysis. Increasing the catalyst inlet temperature from 335°C (635°F) to 391°C (735°F) resulted in an increase of destruction efficiency from 88.7 to 92.4 percent. As indicated in Table 5-5, natural gas consumption is increased as the catalyst inlet temperature increases. It should also be noted from Table 5-5 that raising the catalyst inlet temperature also results in a reduction in the outlet THC concentration from the incinerator.

Table 5-6 gives incinerator destruction efficiencies for a range of inlet THC concentrations measured at the same catalyst inlet temperature. With the exception of one monitoring period (2/4/83: 1017-1117), the destruction efficiencies were between 88 and 89 percent regardless of inlet THC concentration. Thus, it appears that for the relatively narrow range of inlet concentrations measured at Plant C-4, the destruction efficiency remains constant.

The relationship between the mass of solvent destroyed by the incinerator at Plant C-4 and the temperature rise across the catalyst bed is illustrated in Figure 5-2. As expected, a higher temperature rise across the catalyst bed occurs with increased solvent destruction in the incinerator.

### 5.2.3 Gas Chromatography Results

During testing at Plant C-4, samples of incinerator inlet and outlet gas were analyzed using a gas chromatograph (GC). The purpose of these

TABLE 5-5. EFFECT OF CATALYST BED INLET TEMPERATURE ON INCINERATOR EFFICIENCY

| Date | Monitoring Period | Product | THC Concentration (ppmv-C)[a] | | Catalyst Bed Temperature °C (°F) | | Efficiency | Natural Gas Usage |
|---|---|---|---|---|---|---|---|---|
| | | | Inlet | Outlet | Inlet | Outlet | | $m^3/s$ (cfm) |
| 2/3/83<br>2/5/83 | 1300 - 1911<br>2051 - 2301<br>0159 - 0310<br>0319 - 0534 | B | 5,944[b] | 611[b] | 335 (635)[b] | 397 (746)[b] | 88.7[b] | 0.015 (32) |
| 2/4/83 | 1440 - 1710 | B | 6,060 | 495 | 368 (695) | 432 (810) | 91.0 | 0.019 (40) |
| 2/4/83 - 2/5/83 | 2259 - 0101 | B | 5,275 | 363 | 391 (735) | 452 (845) | 92.4 | 0.020 (42) |

[a] ppmv-C = parts per million by volume as carbon.

[b] Average of test results during the indicated monitoring periods.

TABLE 5-6. EFFECT OF INLET THC CONCENTRATION ON INCINERATOR EFFICIENCY

| Date | Monitoring Period | Product | THC Concentration (ppmv-C)[a] | | Catalyst Bed Temperature °C (°F) | | Efficiency |
|---|---|---|---|---|---|---|---|
| | | | Inlet | Outlet | Inlet | Outlet | |
| 2/5/83 | 0608 - 1113 | B | 4,714 | 501 | 332 (630) | 388 (730) | 88.3 |
| 2/4/83 | 1017 - 1117 | B | 4,725 | 546 | 332 (630) | 385 (725) | 87.3 |
| 2/3/83 | 2051 - 2301 | B | 5,484 | 564 | 335 (635) | 385 (725) | 88.7 |
| 2/5/83 | 0159 - 0310 | B | 5,618 | 592 | 335 (635) | 407 (765) | 88.4 |
| 2/3/83 | 1300 - 1911 | B | 5,998 | 601 | 335 (635) | 396 (745) | 88.9 |
| 2/5/83 | 0319 - 0534 | B | 6,418 | 687 | 335 (635) | 407 (765) | 88.2 |

[a] ppmv-C = parts per million by volume as carbon.

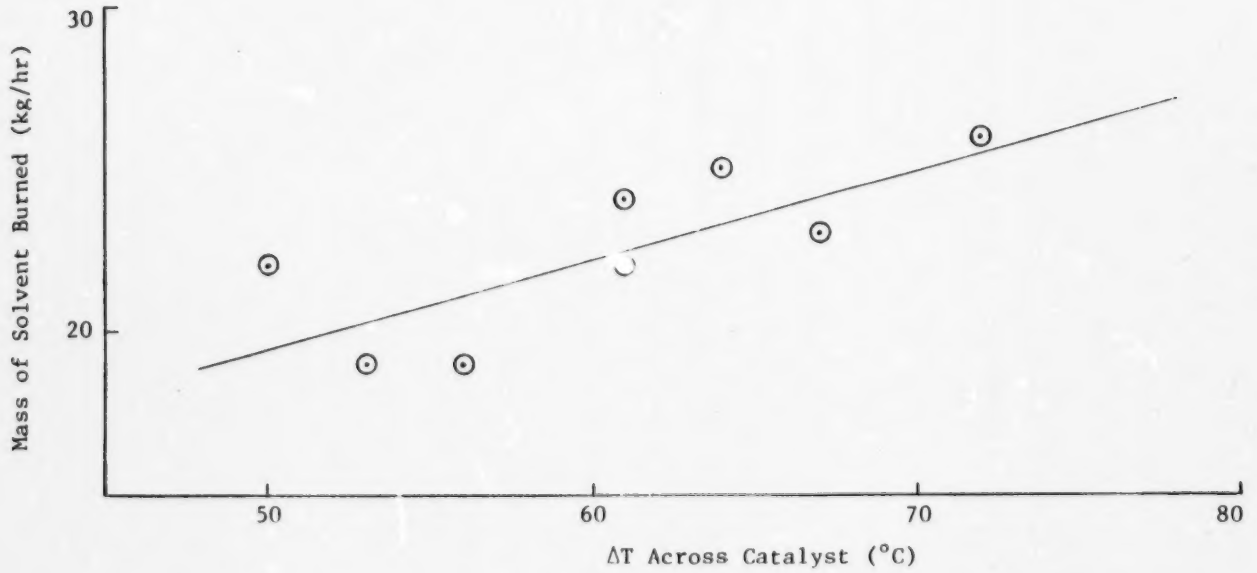


Figure 5-2. Mass of Solvent Burned Versus ΔT Across Catalyst for Product B.

analyses was to quantify individual organic species in the inlet and outlet gas streams for each of the products made during testing.

The results of the GC analyses for Products A and B are summarized in Tables 5-7 and 5-8, respectively. Results are summarized according to catalyst inlet temperature. Both tables present average Method 18 concentrations and standard deviations for all detected compounds in the $C_1$ to $C_6$ range as well as for several compounds with molecular weights greater than $C_6$. GC data collected during testing at Plant C-4 are found in Appendix C.

In some cases, it was possible to identify specific compounds among the organic species detected based on comparison of their retention times against known standards. Specific compounds identified in this manner, including methyl isobutyl ketone (MIBK), toluene, ethyl benzene, and xylene, are noted in Tables 5-7 and 5-8. Other compounds identified by gas chromatography/mass spectrometry (GC/MS) analyses are included in Appendix D.

According to GC results presented for Product A in Table 5-7, the primary component of the gas stream is an unidentified compound with a molecular weight greater than heptane ($C_7$). No GC/MS data are available on Product A to provide a possible identification of this compound. Other major components are ethyl benzene, MIBK, and toluene.

From the GC results in Table 5-8, the primary component of the gas stream for Product B is MIBK. Another major component is an unidentified compound in the $C_5$ to $C_6$ range. According to GC/MS results, this compound could possibly be either n-butyl acetate or 2-ethoxyethyl acetate. Xylene, toluene, and ethyl benzene were also detected at significant levels along with several other unidentified compounds.

TABLE 5-7. SUMMARY OF GAS CHROMATOGRAPH ANALYSES FOR PLANT C-4, PRODUCT A

| Date | Sample Location | Number of Samples | Catalyst Bed Temperature °C (°F) Inlet/Outlet | Average Method 18 Concentration, ppmv-C[a] (Standard Deviation) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $C_1$-$C_4$ | $C_5$-$C_6$ | MIBK | $C_6$-$C_7$ | | | | Ethyl Benzene | $C_7^+$ | | Xylene | | THC |
| | | | | Retention times | | 10.0 | 10.5 | 13.25 | Σ Others | | 15.70 | 16.9 | 20.4 | 22.7 | 24.1 | |
| 1/31/83 - 2/1/83 | Inlet | 4 | 318 (605)/371 (700) | ND[b] | 505 (12) | 322 (25) | 405 (23) | 22.7 (5.3) | 36.5 (5.9) | | 8.97 (6.52) | 504 (22) | 1,266 (77) | 302 (11) | 401 (21) | 3,770 (172) |
| | Outlet | 2 | 318 (605)/371 (700) | ND | ND | 32.6 (17.7) | ND | ND | ND | | ND | 30.9 (3.3) | 62.9 (4.8) | 11 (1) | 11 (1) | 149 (3) |

[a] ppmv-C = parts per million by volume as carbon quanitated against propane.

[b] ND = not detected. Detection limit = 3.0 ppmv-C.

TABLE 5-8. SUMMARY OF GAS CHROMATOGRAPH ANALYSES FOR PLANT C-4, PRODUCT B

| Date | Sample Location | Number of Samples | Catalyst Bed Temperature °C (°F) Inlet/Outlet | Average Method 18 Concentration, ppmv-C[a] (Standard Deviation) | | | | | | | | | | | | | THC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $C_3$ | $C_4$ | | $C_5$-$C_6$ | | ← MIBK $C_6$-$C_7$ → | | ← Ethyl Benezene | | ... $C_7$+ Xylene → | | | | |
| | | | | Retention times | 3.3 | 5.5 | 6.3 | 7.3 | 9.7 | 12.4 | 15.7 | 18.0 | 22.4 | 24.4 | 26.2 | | |
| 2/3/83 | Inlet | 5 | 335 (635)/396 (745) | ND[b] | ND | 4.21 (0.99) | 102 (8) | 726 (43) | 1,870 (39) | 71.6 (9.1) | 134 (13) | 59.4 (1.2) | 180 (24) | 62.4 (9.7) | 55.4 (5.7) | 3,260 (108) | |
| | Outlet | 1 | 335 (635)/396 (745) | 6.41 | 5.23 | ND | ND | 19 | 269 | 8.17 | 2.4 | ND | ND | 2.4 | ND | 313 | |
| 2/4/83 | Inlet | 2 | 368 (695)/432 (810) | ND | ND | 3.9 (2.5) | 117 (42) | 755 (155) | 2,010 (318) | 84.1 (16.7) | 188 (11.3) | 69.4 (4.4) | 209 (51) | 61.6 (7.8) | 60.3 (6.1) | 3,560 (617) | |
| | Outlet | 4 | 363 (685)/443 (830) | 2.19 (1.54) | 5.81 (1.70) | ND | ND | ND | 233 (11) | 7.35 (1.0) | ND | ND | ND | ND | ND | 248 (12) | |
| 2/4/83 | Inlet | 2 | 377 (710)/454 (850) | ND | ND | 4.9 (1.0) | 117 (5) | 756 (28) | 1,940 (76) | 86.5 (2.2) | 177 (5) | 58.5 (1.1) | 199 (3) | 53.6 (0.8) | 50.5 (0.4) | 3,440 (101) | |
| | Outlet | 3 | 391 (735)/452 (845) | 1.8 (0.5) | 4.19 (1.22) | ND | ND | ND | 188 (16) | 5.74 (0.99) | ND | ND | ND | ND | ND | 197 (20) | |
| 2/5/83 | Inlet | 1 | 332 (630)/388 (730) | ND | ND | 2.8 | 95 | 636 | 1,602 | ← | | | 683[c] | | → | 3,020[d] | |
| | Outlet | 3 | 332 (630)/388 (730) | 2.0 (0.9) | 13.0 (2.0) | ND | ND | ND | 295 (37) | 8.96 (3.83) | 2.8 (2.3) | 2.8 (2.3) | ND | ND | ND | 321 (39) | |

[a] ppmv-C = parts per million by volume as carbon quantitated against propane.

[b] ND = not detected. Detection limit = 3.0 ppmv-C.

[c] Total for all $C_7$+ compounds.

[d] Inlet THC concentrations measured by backflushing all components before chromatographic elution were 3,520 and 3,620 ppmv-C.

The average destruction efficiencies for various VOC components are summarized in Table 5-9 according to product and catalyst inlet temperature. Destruction efficiencies for individual components were based on inlet and outlet Method 18 concentrations and the gas flowrates presented in Section 5.1. Also shown in Table 5-9 are the approximate 95 percent confidence intervals for each destruction efficiency based on the variability of the Method 18 measurements.[2] In most cases, the confidence intervals for the component destruction efficiencies overlap and the relative destruction efficiencies for the four components were not found to be statistically different. However, based on the data for Product A, it appears that xylene is more easily destroyed in the incinerator than ethyl benzene. The destruction efficiency for xylene in Product A is between 95.0 and 96.9 percent while ethyl benzene has a lower efficiency between 91.3 and 95.0 percent.

No conclusions can be made regarding the relative destruction efficiencies of MIBK and toluene or the effect of temperature on the destruction efficiency of these two components. The 95 percent confidence intervals for the destruction efficiencies of MIBK and toluene in Product B overlap in all cases. The confidence intervals overlap because the number of samples collected is statistically small and the standard deviation of the measured concentrations is large.

A comparison of the average THC destruction efficiencies measured by Method 25A and Method 18 is presented in Table 5-10 for Products A and B. While the destruction efficiencies measured according to Method 18 are slightly higher in all cases, the two test methods are in quite good agreement.

TABLE 5-9. DESTRUCTION EFFICIENCY OF VOC COMPONENTS - PLANT C-4

| Date | Product ID | Catalyst Bed Temperature °C (°F) Inlet/Outlet | Mean Destruction Efficiency[a] (Approximate 95% Confidence Interval) MIBK | Toluene | Ethyl Benzene | Xylene | THC |
|---|---|---|---|---|---|---|---|
| 1/3/83 - 2/1/83 | A | 318 (605)/371 (700) | 88.8 (73.7, 100) | -[b] | 93.2 (91.3, 95.0) | 96.0 (95.0, 96.9) | 95.6 (95.2, 96.0) |
| 2/3/83 | B | 335 (635)/396 (745) | 84.1 (79.6, 88.5) | 87.4 (75.0, 97.6) | -[c] | -[c] | 89.4 (86.1, 92.5) |
| 2/4/83 | B | 360 (680)/438 (820) | 87.2 (78.5, 91.1) | 90.3 (79.3, 94.2) | -[c] | -[c] | 92.3 (86.3, 94.8) |
| 2/4/83 | B | 391 (735)/452 (845) | 89.3 (87.1, 91.1) | 92.7 (90.8, 94.4) | -[c] | -[c] | 93.6 (92.3, 94.7) |

[a]Based on inlet and outlet mass flowrates and Method 18 concentrations quanitated against propane.

[b]Toluene not detected in Product A.

[c]Outlet concentration was below detection limit of 3.0 ppmv-C.

TABLE 5-10. COMPARISON OF METHOD 18 AND METHOD 25A DESTRUCTION EFFICIENCIES - PLANT C-4

| Product ID | Catalyst Bed Temperature Inlet/Outlet °C (°F) | Method 18 THC Destruction Efficiency[a] | Method 25A Destruction Efficiency[b] |
|---|---|---|---|
| A | 318/382 (605/720) | 95.6 | 94.0 |
| B | 335/397 (635/746) | 89.4 | 88.7 |
| B | 368/432 (695/810) | 92.3 | 91.0 |
| B | 391/452 (735/845) | 93.6 | 92.4 |

[a]Data from Table 5-9.

[b]Data from Tables 5-3 and 5-5.

## SECTION 5 REFERENCES


1. Himmelblau, David M. Basic Principles and Calculations in Chemical Engineering. Third Edition. Prentice-Hall, Inc. Englewood Cliffs, New Jersey. 1974.

2. Lewis, D. L. and J. I. Steinmetz. Performance of Catalytic Incinerators at Industrial Sites: Quality Assurance Report. (Prepared for U. S. Environmental Protection Agency, Research Triangle Park, North Carolina) EPA Contract No. 68-02-3171, Task 50.

# APPENDIX A

## METHOD 25A SAMPLING RESULTS

Method 25A sampling data are presented in this appendix. Each section of the appendix contains different data sampling locations as follows:

Section A.1 - Incinerator Inlet
Section A.2 - Incinerator Outlet

Breaks in the data are due to (1) calibration of the Byron analyzers, (2) prolonged shutdowns of the manufacturing process, or (3) instrument malfunctions.

The data tabulated in the following sections are expressed in ppmv as carbon ($C_1$). Data given at one-minute intervals were collected with the Byron 401 in the total hydrocarbon (THC) mode. Data given at three minute intervals were collected with the Byron 301 in the methane ($CH_4$) and nonmethane hydrocarbon (NMHC) mode. Data given at twelve-minute intervals were collected with the Byron 401 in the full-scan mode.

Two formats are used in the data listings. The outlet THC concentrations are presented in a five column arrangement. The first column contains the date on which the sampling was performed. The second column gives the time at which the sample was taken for the concentration given in column five of that row. Columns three through five contain from one to three consecutive concentrations ending at the time given in column two of that row. The time interval between successive concentration values in a row is one minute.

The format for the inlet concentrations and outlet full-scan concentrations is similar, but only three columns instead of five are used. The first two columns again contain the date of sampling and the time of sampling resulting in the concentration given in column three of that row.



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SECTION A.1

INLET CONCENTRATIONS

## INLET $CH_4$ CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 1/31/83 | 21:42 | 14.9 |
| | 21:45 | 11.9 |
| | 21:48 | 14.9 |
| | 21:51 | 11.9 |
| | 21:54 | 14.9 |
| | 21:57 | 14.9 |
| | 22:00 | 14.9 |
| | 22:03 | 14.9 |
| | 22:06 | 14.9 |
| | 22:09 | 17.9 |
| | 22:12 | 14.9 |
| | 22:15 | 14.9 |
| | 22:18 | 14.9 |
| | 22:21 | 17.9 |
| | 22:24 | 14.9 |
| | 22:27 | 17.9 |
| | 22:30 | 14.9 |
| | 22:33 | 14.9 |
| | 22:36 | 14.9 |
| | 22:39 | 14.9 |
| | 22:42 | 14.9 |
| | 22:45 | 14.9 |
| | 22:48 | 17.9 |
| | 22:51 | 17.9 |
| | 22:54 | 14.9 |
| 2/1/83 | 07:27 | 23.9 |
| | 07:30 | 14.9 |
| | 07:33 | 11.9 |
| | 07:36 | 17.9 |
| | 07:39 | 14.9 |
| | 07:42 | 17.9 |
| | 07:45 | 17.9 |
| | 07:48 | 17.9 |
| | 07:51 | 20.9 |
| | 07:54 | 23.9 |
| | 07:57 | 17.9 |
| | 08:00 | 17.9 |
| | 08:03 | 17.9 |
| | 08:06 | 17.9 |
| | 08:09 | 17.9 |
| 2/1/83 | 19:31 | 17.4 |
| | 19:34 | 14.2 |
| | 19:37 | 16.6 |
| | 19:40 | 17.4 |
| | 19:43 | 17.4 |
| | 19:46 | 21.4 |
| | 19:49 | 16.6 |
| | 19:52 | 18.2 |
| | 19:55 | 19 |
| | 19:58 | 19 |
| | 20:01 | 19 |
| | 20:04 | 17.4 |
| | 20:07 | 19.8 |
| | 20:10 | 19.8 |
| | 20:13 | 15.8 |
| | 20:16 | 19.8 |
| | 20:19 | 20.6 |
| | 20:22 | 19 |
| | 20:25 | 18.2 |
| | 20:28 | 19 |
| | 20:31 | 18.2 |
| | 20:34 | 19 |
| | 20:37 | 19.8 |
| | 20:40 | 18.2 |
| | 20:43 | 17.4 |
| | 20:46 | 17.4 |
| | 20:49 | 17.4 |
| | 20:52 | 20.6 |
| | 20:55 | 18.2 |
| | 20:58 | 18.2 |
| | 21:01 | 18.2 |
| 2/2/83 | 08:15 | 15.8 |
| | 08:18 | 19 |
| | 08:21 | 16.6 |
| | 08:24 | 17.4 |
| | 08:27 | 15 |
| 2/3/83 | 13:00 | 21.7 |
| | 13:03 | 23.3 |
| | 13:06 | 16.1 |
| | 13:09 | 16.9 |
| | 13:12 | 21.7 |
| | 13:15 | 20.9 |
| | 13:18 | 23.3 |
| | 13:21 | 23.3 |
| | 13:24 | 20.1 |
| | 13:27 | 21.7 |
| | 13:30 | 19.3 |
| | 13:33 | 20.1 |
| | 13:36 | 21.7 |
| | 13:39 | 20.9 |
| | 13:42 | 21.7 |
| | 13:45 | 22.5 |
| | 13:48 | 20.9 |
| | 13:51 | 21.7 |
| | 13:54 | 20.1 |
| | 13:57 | 23.3 |
| 2/3/83 | 14:00 | 20.9 |
| | 14:03 | 22.5 |
| | 14:06 | 24.1 |
| | 14:09 | 20.9 |
| | 14:12 | 20.9 |
| | 14:15 | 20.1 |
| | 14:18 | 21.7 |
| | 14:21 | 21.7 |
| | 14:24 | 21.7 |
| | 14:27 | 21.7 |
| | 14:30 | 21.7 |
| | 14:33 | 21.7 |
| | 14:36 | 21.7 |
| | 14:39 | 21.7 |
| | 14:42 | 20.9 |
| | 14:45 | 21.7 |
| | 14:48 | 21.7 |
| | 14:51 | 20.9 |
| | 14:54 | 20.9 |
| | 14:57 | 21.7 |
| | 15:00 | 21.7 |
| | 15:03 | 20.9 |
| | 15:06 | 19.3 |
| | 15:09 | 22.5 |
| | 15:12 | 20.9 |
| | 15:53 | 21.7 |
| | 15:56 | 20.9 |
| | 16:01 | 20.9 |
| | 16:04 | 20.9 |
| | 16:07 | 21.7 |
| | 16:16 | 21.7 |
| | 16:19 | 20.9 |
| | 16:22 | 22.5 |
| | 16:25 | 21.7 |
| | 16:28 | 19.3 |
| | 16:31 | 21.7 |
| | 16:34 | 20.9 |
| | 16:37 | 20.9 |
| | 16:40 | 19.3 |
| | 16:43 | 20.9 |
| | 16:46 | 21.7 |
| | 16:53 | 20.9 |
| | 16:56 | 20.9 |
| | 16:59 | 20.9 |
| | 17:02 | 20.9 |
| | 17:05 | 22.5 |
| | 17:08 | 22.5 |
| | 17:11 | 20.9 |
| | 17:14 | 20.1 |
| | 17:17 | 20.9 |
| | 17:20 | 20.9 |
| | 17:23 | 22.5 |
| | 17:26 | 20.9 |
| | 17:29 | 22.5 |
| | 17:32 | 20.1 |



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## INLET $CH_4$ CONCENTRATIONS

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| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/3/83 | 17:35 | 11.2 |
| | 17:38 | 23.3 |
| | 17:41 | 21.7 |
| | 17:44 | 21.3 |
| | 17:47 | 21.7 |
| | 17:50 | 23.3 |
| | 17:53 | 21.7 |
| | 17:56 | 22.1 |
| | 17:59 | 22.5 |
| | 18:02 | 24.1 |
| | 18:05 | 22.1 |
| | 18:08 | 20.5 |
| | 18:11 | 21.3 |
| | 18:14 | 24.1 |
| | 18:17 | 23.3 |
| | 18:20 | 22.5 |
| | 18:23 | 21.3 |
| | 19:26 | 22.9 |
| | 18:29 | 23.3 |
| | 18:32 | 22.1 |
| | 18:35 | 23.3 |
| | 18:38 | 22.9 |
| | 18:41 | 22.9 |
| | 18:44 | 22.5 |
| | 18:47 | 21.7 |
| | 18:50 | 22.1 |
| | 18:53 | 21.7 |
| | 18:56 | 22.5 |
| | 18:59 | 22.1 |
| | 19:02 | 21.7 |
| | 19:05 | 21.7 |
| | 19:08 | 20.9 |
| | 19:11 | 21.3 |
| | 20:53 | 18.9 |
| | 20:56 | 20.5 |
| | 20:59 | 22.1 |
| | 21:02 | 20.1 |
| | 21:05 | 23.7 |
| | 21:08 | 22.1 |
| | 21:11 | 20.5 |
| | 21:14 | 20.5 |
| | 21:17 | 21.3 |
| | 21:20 | 21.3 |
| | 21:23 | 21.3 |
| | 21:26 | 22.1 |
| | 21:29 | 22.1 |
| | 21:32 | 23.3 |
| | 21:35 | 22.9 |
| | 21:38 | 21.3 |
| | 21:41 | 24.9 |
| | 21:44 | 22.1 |
| | 21:47 | 20.1 |
| | 21:50 | 20.5 |
| | 21:53 | 21.7 |
| | 21:56 | 22.5 |
| | 21:59 | 20.5 |
| | 22:02 | 20.9 |

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/3/83 | 22:05 | 20.9 |
| | 22:08 | 22.1 |
| | 22:11 | 21.7 |
| | 22:14 | 22.5 |
| | 22:17 | 20.5 |
| | 22:20 | 21.7 |
| | 22:23 | 22.1 |
| | 22:26 | 22.5 |
| | 22:29 | 19.3 |
| | 22:32 | 21.7 |
| | 22:35 | 22.9 |
| | 22:38 | 21.7 |
| | 22:41 | 21.3 |
| | 22:44 | 21.3 |
| | 22:47 | 20.9 |
| | 22:50 | [illegible] |
| | 22:53 | [illegible] |
| | 22:56 | [illegible] |
| | 22:59 | 21.7 |
| | 23:02 | 21.3 |
| 2/4/83 | 10:17 | 19.5 |
| | 10:20 | 18.6 |
| | 10:23 | 20.4 |
| | 10:26 | 20.4 |
| | 10:29 | 18.6 |
| | 10:32 | 18.6 |
| | 10:35 | 16.8 |
| | 10:38 | 18.6 |
| | 10:41 | 15.9 |
| | 10:44 | 18.6 |
| | 10:47 | 18.6 |
| | 10:50 | 18.6 |
| | 10:53 | 18.6 |
| | 10:56 | 19.5 |
| | 10:59 | 20.4 |
| | 11:02 | 17.7 |
| | 11:05 | 19.5 |
| | 11:08 | 18.6 |
| | 11:11 | 19.5 |
| | 11:14 | 17.7 |
| | 11:17 | 19.5 |
| | 12:13 | 20.4 |
| | 12:16 | 21.3 |
| | 12:19 | 18.6 |
| | 12:22 | 18.6 |
| | 14:40 | 18.6 |
| | 14:43 | 16.8 |
| | 14:46 | 17.7 |
| | 14:49 | 17.7 |
| | 14:52 | 16.8 |
| | 14:55 | 18.6 |
| | 14:58 | 18.6 |
| | 15:01 | 17.7 |
| | 15:04 | 17.7 |
| | 15:07 | 18.6 |

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/4/83 | 15:10 | 18.6 |
| | 15:13 | 17.7 |
| | 15:16 | 17.7 |
| | 15:19 | 22.2 |
| | 15:22 | 18.6 |
| | 15:25 | 18.6 |
| | 15:28 | 19.5 |
| | 15:31 | 18.6 |
| | 15:34 | 19.5 |
| | 15:37 | 18.6 |
| | 15:40 | 17.7 |
| | 15:43 | 17.7 |
| | 15:46 | 17.7 |
| | 15:49 | 17.7 |
| | 15:52 | 17.7 |
| | 15:55 | 15.9 |
| | 15:58 | 19.5 |
| | 16:01 | 15.9 |
| | 16:04 | 18.6 |
| | 16:07 | 15.9 |
| | 16:10 | 17.7 |
| | 16:13 | 18.6 |
| | 16:16 | 16.8 |
| | 16:19 | 15.9 |
| | 16:22 | 18.6 |
| | 16:25 | 15.9 |
| | 16:28 | 15.9 |
| | 16:31 | 16.8 |
| | 16:34 | 17.7 |
| | 16:37 | 16.8 |
| | 16:40 | 18.6 |
| | 16:43 | 15.9 |
| | 16:46 | 17.7 |
| | 16:49 | 15.9 |
| | 16:52 | 17.7 |
| | 16:55 | 18.6 |
| | 16:58 | 17.7 |
| | 17:01 | 16.8 |
| | 17:04 | 15.9 |
| | 17:07 | 16.8 |
| | 17:10 | 15.9 |
| | 18:25 | 18.6 |
| | 18:28 | 17.7 |
| | 18:31 | 18.6 |
| | 18:34 | 16.8 |
| | 18:37 | 15.9 |
| | 18:40 | 15.1 |
| | 18:43 | 15.9 |
| | 18:46 | 15.9 |
| | 18:49 | 18.6 |
| | 18:52 | 15.9 |
| | 18:55 | 18.6 |
| | 18:58 | 18.6 |
| | 19:01 | 18.6 |
| | 19:04 | 15.1 |
| | 19:07 | 18.6 |
| | 19:10 | 17.7 |
| | 19:13 | 16.8 |
| | 19:16 | 17.7 |

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## INLET $CH_4$ CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/4/83 | 19:19 | 17.7 |
| | 19:22 | 19.5 |
| | 19:25 | 19.5 |
| | 19:28 | 18.6 |
| | 19:31 | 17.7 |
| | 19:34 | 17.7 |
| | 19:37 | 17.7 |
| | 19:40 | 19.5 |
| | 19:43 | 18.6 |
| | 19:46 | 16.8 |
| | 19:49 | 20.4 |
| | 19:52 | 19.5 |
| | 19:55 | 17.7 |
| | 19:58 | 17.7 |
| | 20:01 | 21.3 |
| | 20:04 | 17.7 |
| | 20:07 | 19.5 |
| | 20:10 | 19.5 |
| | 20:13 | 19.5 |
| | 20:16 | 17.7 |
| | 20:19 | 18.6 |
| | 20:22 | 19.5 |
| | 20:25 | 19.5 |
| | 20:28 | 18.6 |
| | 20:31 | 17.7 |
| | 20:34 | 22.2 |
| | 20:37 | 18.6 |
| | 20:40 | 20.4 |
| | 20:43 | 18.6 |
| | 20:46 | 18.6 |
| | 20:49 | 18.6 |
| | 20:52 | 17.7 |
| | 20:55 | 19.5 |
| | 20:58 | 18.6 |
| | 21:01 | 17.7 |
| | 21:04 | 16.8 |
| | 21:07 | 18.6 |
| | 21:10 | 19.5 |
| | 21:13 | 18.6 |
| | 21:16 | 18.6 |
| | 21:19 | 17.7 |
| | 21:22 | 17.7 |
| | 21:25 | 18.6 |
| | 21:28 | 15.9 |
| | 21:31 | 15.9 |
| | 21:34 | 19.5 |
| | 21:37 | 19.5 |
| | 21:40 | 17.7 |
| | 21:43 | 17.7 |
| | 21:46 | 20.4 |
| | 21:49 | 18.6 |
| | 21:52 | 17.7 |
| | 21:55 | 18.6 |
| | 21:58 | 16.8 |
| | 22:01 | 16.8 |
| | 22:04 | 17.7 |
| | 22:07 | 16.8 |
| | 22:10 | 15.9 |
| | 22:13 | 17.7 |
| 2/4/83 | 22:21 | 18.6 |
| | 22:24 | 19.5 |
| | 22:27 | 15.9 |
| | 22:30 | 17.7 |
| | 22:33 | 17.7 |
| | 22:36 | 17.7 |
| | 22:39 | 22.2 |
| | 22:42 | 19.5 |
| | 23:01 | 19.5 |
| | 23:04 | 20.4 |
| | 23:07 | 18.6 |
| | 23:10 | 19.5 |
| | 23:13 | 19.5 |
| | 23:16 | 18.6 |
| | 23:19 | 18.6 |
| | 23:22 | 20.4 |
| | 23:25 | 19.5 |
| | 23:28 | 19.5 |
| | 23:31 | 18.6 |
| | 23:34 | 19.5 |
| | 23:37 | 20.4 |
| | 23:40 | 18.6 |
| | 23:43 | 19.5 |
| | 23:46 | 19.5 |
| | 23:49 | 19.5 |
| | 23:52 | 19.5 |
| | 23:55 | 19.5 |
| | 23:58 | 20.4 |
| 2/5/83 | 00:01 | 19.5 |
| | 00:04 | 17.7 |
| | 00:07 | 17.7 |
| | 00:10 | 16.8 |
| | 00:13 | 19.5 |
| | 00:16 | 18.6 |
| | 00:19 | 16.8 |
| | 00:22 | 18.6 |
| | 00:25 | 23.1 |
| | 00:28 | 23.1 |
| | 00:31 | 20.4 |
| | 00:34 | 22.2 |
| | 00:37 | 19.5 |
| | 00:40 | 21.3 |
| | 00:43 | 18.6 |
| | 00:46 | 21.3 |
| | 00:49 | 20.4 |
| | 00:52 | 19.5 |
| | 00:55 | 21.3 |
| | 00:58 | 20.4 |
| | 01:01 | 22.2 |
| | 01:04 | 20.4 |
| | 01:07 | 20.4 |
| | 01:10 | 22.2 |
| | 01:13 | 20.4 |
| | 01:16 | 18.6 |
| | 01:19 | 20.4 |
| | 01:22 | 19.5 |
| | 01:25 | 20.4 |
| | 01:28 | 20.4 |
| | 01:31 | 22.2 |
| | 01:34 | 18.6 |
| 2/5/83 | 01:37 | 22.2 |
| | 01:40 | 23.1 |
| | 01:43 | 20.4 |
| | 01:46 | 18.6 |
| | 01:49 | 21.3 |
| | 01:52 | 20.4 |
| | 01:55 | 22.2 |
| | 01:58 | 20.4 |
| | 02:01 | 20.4 |
| | 02:04 | 21.3 |
| | 02:07 | 22.2 |
| | 02:10 | 22.2 |
| | 02:13 | 20.4 |
| | 02:16 | 22.2 |
| | 02:19 | 20.4 |
| | 02:22 | 22.2 |
| | 02:25 | 19.5 |
| | 02:28 | 20.4 |
| | 02:31 | 20.4 |
| | 02:34 | 20.4 |
| | 02:37 | 18.6 |
| | 02:40 | 19.5 |
| | 02:43 | 21.3 |
| | 02:46 | 19.5 |
| | 02:49 | 20.4 |
| | 02:52 | 22.2 |
| | 02:55 | 20.4 |
| | 02:58 | 21.3 |
| | 03:01 | 20.4 |
| | 03:04 | 22.2 |
| | 03:07 | 20.4 |
| | 03:10 | 22.2 |
| | 03:19 | 22.2 |
| | 03:22 | 19.5 |
| | 03:25 | 19.5 |
| | 03:28 | 19.5 |
| | 03:31 | 20.4 |
| | 03:34 | 20.4 |
| | 03:37 | 22.2 |
| | 03:40 | 19.5 |
| | 03:43 | 20.4 |
| | 03:46 | 21.3 |
| | 03:49 | 18.6 |
| | 03:52 | 19.5 |
| | 03:55 | 20.4 |
| | 03:58 | 19.5 |
| | 04:01 | 19.5 |
| | 04:04 | 19.5 |
| | 04:07 | 18.6 |
| | 04:10 | 19.5 |
| | 04:13 | 19.5 |
| | 04:16 | 18.6 |
| | 04:19 | 20.4 |
| | 04:22 | 20.4 |
| | 04:25 | 18.6 |
| | 04:28 | 18.6 |
| | 04:31 | 19.5 |
| | 04:34 | 19.5 |
| | 04:37 | 20.4 |
| | 04:40 | 19.5 |
| | 04:43 | 22.2 |
| | 04:46 | 19.5 |
| | 04:49 | 22.2 |

## INLET $CH_4$ CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/5/83 | 04:52 | 19.5 |
| | 04:55 | 19.5 |
| | 04:58 | 22.2 |
| | 05:01 | 20.4 |
| | 05:04 | 20.4 |
| | 05:07 | 20.4 |
| | 05:10 | 21.3 |
| | 05:13 | 20.4 |
| | 05:16 | 21.3 |
| | 05:19 | 18.6 |
| | 05:22 | 19.5 |
| | 05:25 | 18.6 |
| | 05:28 | 19.5 |
| | 05:31 | 21.3 |
| | 05:34 | 20.4 |
| | 06:10 | 19.5 |
| | 06:13 | 20.4 |
| | 06:16 | 18.6 |
| | 06:19 | 23.1 |
| | 06:22 | 25.7 |
| | 06:25 | 16.8 |
| | 06:28 | 20.4 |
| | 06:31 | 20.4 |
| | 06:34 | 19.5 |
| | 06:37 | 18.6 |
| | 06:40 | 26.6 |
| | 06:43 | 20.4 |
| | 06:46 | 18.6 |
| | 06:49 | 20.4 |
| | 06:52 | 20.4 |
| | 06:55 | 20.4 |
| | 06:58 | 20.4 |
| | 07:01 | 20.4 |
| | 07:04 | 21.3 |
| | 07:07 | 21.3 |
| | 07:10 | 22.2 |
| | 07:13 | 19.5 |
| | 07:16 | 18.6 |
| | 07:19 | 19.5 |
| | 07:22 | 20.4 |
| | 07:25 | 18.6 |
| | 07:28 | 19.5 |
| | 07:31 | 19.5 |
| | 07:34 | 20.4 |
| | 07:37 | 20.4 |
| | 07:40 | 21.3 |
| | 07:43 | 19.5 |
| | 07:46 | 20.4 |
| | 07:49 | 19.5 |
| | 07:52 | 18.6 |
| | 07:55 | 18.6 |
| | 07:58 | 18.6 |
| | 08:01 | 18.3 |
| | 08:04 | 17.7 |
| | 08:07 | 18.6 |
| 2/5/83 | 08:14 | 20.4 |
| | 08:17 | 18.6 |
| | 08:20 | 18.6 |
| | 08:23 | 18.6 |
| | 08:26 | 18.6 |
| | 08:29 | 19.5 |
| | 08:32 | 20.4 |
| | 08:35 | 19.5 |
| | 08:38 | 18.6 |
| | 08:41 | 18.6 |
| | 08:44 | 19.5 |
| | 08:47 | 18.6 |
| | 08:52 | 23.1 |
| | 08:55 | 18.6 |
| | 08:58 | 19.5 |
| | 09:01 | 19.5 |
| | 09:04 | 19.5 |
| | 09:07 | 21.3 |
| | 09:10 | 18.6 |
| | 09:13 | 19.5 |
| | 09:16 | 19.5 |
| | 09:19 | 17.7 |
| | 09:22 | 19.5 |
| | 09:25 | 20.4 |
| | 09:28 | 19.5 |
| | 09:31 | 19.5 |
| | 09:34 | 19.5 |
| | 09:37 | 19.5 |
| | 09:40 | 21.3 |
| | 09:43 | 19.5 |
| | 09:46 | 18.6 |
| | 09:49 | 22.2 |
| | 09:52 | 20.4 |
| | 09:55 | 17.7 |
| | 09:58 | 18.6 |
| | 10:01 | 15.9 |
| | 10:04 | 18.6 |
| | 10:07 | 17.7 |
| | 10:10 | 17.7 |
| | 10:13 | 17.7 |
| | 10:16 | 17.7 |
| | 10:19 | 15.1 |
| | 10:22 | 15.1 |
| | 10:25 | 16.8 |
| | 10:28 | 17.7 |
| | 10:31 | 15.1 |
| | 10:34 | 19.5 |
| | 10:37 | 18.6 |
| | 10:40 | 18.6 |
| | 10:43 | 17.7 |
| | 10:46 | 17.7 |
| | 10:49 | 18.6 |
| | 10:52 | 17.7 |
| | 10:55 | 19.5 |
| | 10:58 | 18.6 |
| | 11:01 | 18.6 |
| | 11:04 | 18.6 |
| | 11:07 | 18.6 |
| | 11:10 | 18.6 |
| | 11:13 | 16.8 |

## INLET NMHC CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 1/31/83 | 21;42 | 8410 |
| | 21;45 | 6994 |
| | 21;48 | 8056 |
| | 21;51 | 7835 |
| | 21;54 | 8145 |
| | 21;57 | 8366 |
| | 22;00 | 8499 |
| | 22;03 | 8322 |
| | 22;06 | 8322 |
| | 22;09 | 3851 |
| | 22;12 | 8101 |
| | 22;15 | 7569 |
| | 22;18 | 8012 |
| | 22;21 | 8012 |
| | 22;24 | 8101 |
| | 22;27 | 8189 |
| | 22;30 | 7923 |
| | 22;33 | 8233 |
| | 22;36 | 1903 |
| | 22;39 | 8012 |
| | 22;42 | 8278 |
| | 22;45 | 8145 |
| | 22;48 | 8056 |
| | 22;51 | 8012 |
| | 22;54 | 5179 |
| 2/1/83 | 07;27 | 6463 |
| | 07;30 | 7437 |
| | 07;33 | 2567 |
| | 07;36 | 734. |
| | 07;39 | 7481 |
| | 07;42 | 7658 |
| | 07;45 | 7481 |
| | 07;48 | 7658 |
| | 07;51 | 7437 |
| | 07;54 | 5223 |
| | 07;57 | 7038 |
| | 08;00 | 5622 |
| | 08;03 | 7437 |
| | 08;06 | 7791 |
| | 08;09 | 7348 |

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/1/83 | 19;31 | 4707 |
| | 19;34 | 4659 |
| | 19;37 | 923 |
| | 19;40 | 351 |
| | 19;43 | 131 |
| | 19;46 | 483 |
| | 19;49 | 4351 |
| | 19;52 | 4834 |
| | 19;55 | 4571 |
| | 19;58 | 5054 |
| | 20;01 | 659 |
| | 20;04 | 5406 |
| | 20;07 | 5362 |
| | 20;10 | 3032 |
| | 20;13 | 395 |
| | 20;16 | 4751 |
| | 20;19 | 4878 |
| | 20;22 | 4747 |
| | 20;25 | 4527 |
| | 20;28 | 307 |
| | 20;31 | 527 |
| | 20;34 | 131 |
| | 20;37 | 131 |
| | 20;40 | 395 |
| | 20;43 | 2857 |
| | 20;46 | 1142 |
| | 20;49 | 351 |
| | 20;52 | 307 |
| | 20;55 | 966 |
| | 20;58 | 4263 |
| | 21;01 | 3911 |
| 2/2/83 | 08;15 | 4878 |
| | 08;18 | 4527 |
| | 08;21 | 4659 |
| | 08;24 | 5142 |
| | 08;27 | 3604 |
| 2/3/83 | 13;00 | 6029 |
| | 13;03 | 5982 |
| | 13;06 | 5795 |
| | 13;09 | 5842 |
| | 13;12 | 6122 |
| | 13;15 | 6029 |
| | 13;18 | 6216 |
| | 13;21 | 5982 |
| | 13;24 | 6122 |
| | 13;27 | 6029 |
| | 13;30 | 3739 |
| | 13;33 | 6169 |
| | 13;36 | 6169 |
| | 13;39 | 6216 |
| | 13;42 | 6075 |
| | 13;45 | 6122 |
| | 13;48 | 6075 |
| | 13;51 | 6216 |
| | 13;54 | 6262 |
| | 13;57 | 6356 |

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/3/83 | 14;00 | 5421 |
| | 14;03 | 794 |
| | 14;06 | 5281 |
| | 14;09 | 5842 |
| | 14;12 | 5842 |
| | 14;15 | 5982 |
| | 14;18 | 5795 |
| | 14;21 | 5608 |
| | 14;24 | 5795 |
| | 14;27 | 6029 |
| | 14;30 | 6075 |
| | 14;33 | 6075 |
| | 14;36 | 5982 |
| | 14;39 | 5748 |
| | 14;42 | 5982 |
| | 14;45 | 6309 |
| | 14;48 | 6356 |
| | 14;51 | 6075 |
| | 14;54 | 6262 |
| | 14;57 | 6403 |
| | 15;00 | 6403 |
| | 15;03 | 6075 |
| | 15;06 | 6309 |
| | 15;09 | 5001 |
| | 15;12 | 6216 |
| | 15;53 | 6216 |
| | 15;56 | 6029 |
| | 16;01 | 5795 |
| | 16;04 | 5982 |
| | 16;07 | 6216 |
| | 16;16 | 5608 |
| | 16;19 | 4860 |
| | 16;22 | 6029 |
| | 16;25 | 6029 |
| | 16;28 | 6075 |
| | 16;31 | 6075 |
| | 16;34 | 6075 |
| | 16;37 | 6449 |
| | 16;40 | 6590 |
| | 16;43 | 6403 |
| | 16;46 | 5982 |
| | 16;53 | 6029 |
| | 16;56 | 6029 |
| | 16;59 | 6309 |
| | 17;02 | 6356 |
| | 17;05 | 6496 |
| | 17;08 | 6356 |
| | 17;11 | 6403 |
| | 17;14 | 6449 |
| | 17;17 | 3692 |
| | 17;20 | 6262 |
| | 17;23 | 6403 |
| | 17;26 | 6496 |
| | 17;29 | 6403 |
| | 17;32 | 6122 |



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## INLET NMHC CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/3/83 | 17:35 | 6309 |
| | 17:38 | 6403 |
| | 17:41 | 6543 |
| | 17:44 | 6403 |
| | 17:47 | 6122 |
| | 17:50 | 6122 |
| | 17:53 | 6169 |
| | 17:56 | 6590 |
| | 17:59 | 6590 |
| | 18:02 | 6683 |
| | 18:05 | 6730 |
| | 18:08 | 6590 |
| | 18:11 | 6496 |
| | 18:14 | 6777 |
| | 18:17 | 6879 |
| | 18:20 | 6309 |
| | 18:23 | 6590 |
| | 18:26 | 6449 |
| | 18:29 | 6683 |
| | 18:32 | 6590 |
| | 18:35 | 6730 |
| | 18:38 | 6496 |
| | 18:41 | 6870 |
| | 18:44 | 6590 |
| | 18:47 | 6216 |
| | 18:50 | 6496 |
| | 18:53 | 6636 |
| | 18:56 | 6636 |
| | 18:59 | 6543 |
| | 19:02 | 6730 |
| | 19:05 | 6683 |
| | 19:08 | 6590 |
| | 19:11 | 6636 |
| | 20:53 | 4019 |
| | 20:56 | 5141 |
| | 20:59 | 5374 |
| | 21:02 | 5421 |
| | 21:05 | 5842 |
| | 21:08 | 5561 |
| | 21:11 | 5702 |
| | 21:14 | 5187 |
| | 21:17 | 5795 |
| | 21:20 | 1074 |
| | 21:23 | 5608 |
| | 21:26 | 4440 |
| | 21:29 | 5608 |
| | 21:32 | 5374 |
| | 21:35 | 5935 |
| | 21:38 | 1121 |
| | 21:41 | 4720 |
| | 21:44 | 5842 |
| | 21:47 | 5889 |
| | 21:50 | 5842 |
| | 21:53 | 6216 |
| | 21:56 | 5889 |
| | 21:59 | 6169 |
| | 22:02 | 5608 |

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/3/83 | 22:05 | 5795 |
| | 22:08 | 6169 |
| | 22:11 | 5889 |
| | 22:14 | 6029 |
| | 22:17 | 6169 |
| | 22:20 | 6122 |
| | 22:23 | 5889 |
| | 22:26 | 5842 |
| | 22:29 | 6216 |
| | 22:32 | 6122 |
| | 22:35 | 5842 |
| | 22:38 | 6216 |
| | 22:41 | 3271 |
| | 22:44 | 5748 |
| | 22:47 | 6029 |
| | 22:50 | 5935 |
| | 22:53 | 5935 |
| | 22:56 | 5935 |
| | 22:59 | 6216 |
| | 23:02 | 3224 |
| 2/4/83 | 10:17 | 4083 |
| | 10:20 | 4787 |
| | 10:23 | 4928 |
| | 10:26 | 4740 |
| | 10:29 | 5021 |
| | 10:32 | 5021 |
| | 10:35 | 5021 |
| | 10:38 | 4693 |
| | 10:41 | 2205 |
| | 10:44 | 4552 |
| | 10:47 | 5068 |
| | 10:50 | 5068 |
| | 10:53 | 5397 |
| | 10:56 | 4881 |
| | 10:59 | 3426 |
| | 11:02 | 5021 |
| | 11:05 | 4881 |
| | 11:08 | 4881 |
| | 11:11 | 5068 |
| | 11:14 | 5115 |
| | 11:17 | 4928 |
| | 12:13 | 4364 |
| | 12:16 | 2440 |
| | 12:19 | 4928 |
| | 12:22 | 4975 |
| | 14:40 | 4083 |
| | 14:43 | 5444 |
| | 14:46 | 6195 |
| | 14:49 | 6383 |
| | 14:52 | 6570 |
| | 14:55 | 6289 |
| | 14:58 | 6664 |
| | 15:01 | 6664 |
| | 15:04 | 4552 |
| | 15:07 | 1689 |

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/4/83 | 15:10 | 2205 |
| | 15:13 | 4787 |
| | 15:16 | 5960 |
| | 15:19 | 6617 |
| | 15:22 | 6617 |
| | 15:25 | 4317 |
| | 15:28 | 704 |
| | 15:31 | 375 |
| | 15:34 | 4928 |
| | 15:37 | 6476 |
| | 15:40 | 2628 |
| | 15:43 | 6242 |
| | 15:46 | 6148 |
| | 15:49 | 5960 |
| | 15:52 | 7040 |
| | 15:55 | 6852 |
| | 15:58 | 7274 |
| | 16:01 | 6993 |
| | 16:04 | 7603 |
| | 16:07 | 7697 |
| | 16:10 | 7744 |
| | 16:13 | 7744 |
| | 16:16 | 4740 |
| | 16:19 | 6617 |
| | 16:22 | 7227 |
| | 16:25 | 7603 |
| | 16:28 | 7603 |
| | 16:31 | 7509 |
| | 16:34 | 7744 |
| | 16:37 | 7509 |
| | 16:40 | 7368 |
| | 16:43 | 7003 |
| | 16:46 | 7087 |
| | 16:49 | 7321 |
| | 16:52 | 7603 |
| | 16:55 | 7415 |
| | 16:58 | 7040 |
| | 17:01 | 5491 |
| | 17:04 | 6993 |
| | 17:07 | 7274 |
| | 17:10 | 7415 |
| | 18:25 | 4787 |
| | 18:28 | 6336 |
| | 18:31 | 6617 |
| | 18:34 | 6946 |
| | 18:37 | 3238 |
| | 18:40 | 6805 |
| | 18:43 | 2862 |
| | 18:46 | 7180 |
| | 18:49 | 7180 |
| | 18:52 | 7368 |
| | 18:55 | 4083 |
| | 18:58 | 6899 |
| | 19:01 | 7227 |
| | 19:04 | 7040 |
| | 19:07 | 1220 |
| | 19:10 | 6101 |
| | 19:13 | 6523 |
| | 19:16 | 7134 |



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## INLET NMHC CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/4/83 | 19:19 | 7227 |
| | 19:22 | 7368 |
| | 19:25 | 7180 |
| | 19:28 | 7321 |
| | 19:31 | 5585 |
| | 19:34 | 6805 |
| | 19:37 | 7227 |
| | 19:40 | 7227 |
| | 19:43 | 7040 |
| | 19:46 | 7227 |
| | 19:49 | 6946 |
| | 19:52 | 6993 |
| | 19:55 | 7087 |
| | 19:58 | 7134 |
| | 20:01 | 4036 |
| | 20:04 | 6758 |
| | 20:07 | 7180 |
| | 20:10 | 7134 |
| | 20:13 | 7274 |
| | 20:16 | 7509 |
| | 20:19 | 7368 |
| | 20:22 | 7180 |
| | 20:25 | 7180 |
| | 20:28 | 6993 |
| | 20:31 | 6664 |
| | 20:34 | 6570 |
| | 20:37 | 6805 |
| | 20:40 | 7040 |
| | 20:43 | 7087 |
| | 20:46 | 6946 |
| | 20:49 | 6993 |
| | 20:52 | 7134 |
| | 20:55 | 7321 |
| | 20:58 | 7368 |
| | 21:01 | 7368 |
| | 21:04 | 2534 |
| | 21:07 | 5491 |
| | 21:10 | 6054 |
| | 21:13 | 6430 |
| | 21:16 | 6289 |
| | 21:19 | 6570 |
| | 21:22 | 6289 |
| | 21:25 | 6570 |
| | 21:28 | 6617 |
| | 21:31 | 6476 |
| | 21:34 | 6336 |
| | 21:37 | 5866 |
| | 21:40 | 6289 |
| | 21:43 | 6476 |
| | 21:46 | 6430 |
| | 21:49 | 6289 |
| | 21:52 | 6570 |
| | 21:55 | 6430 |
| | 21:58 | 6476 |
| | 22:01 | 6570 |
| | 22:04 | 6476 |
| | 22:07 | 5819 |
| | 22:10 | 6383 |
| | 22:13 | 6195 |
| 2/4/83 | 22:21 | 6383 |
| | 22:24 | 6617 |
| | 22:27 | 6430 |
| | 22:30 | 6570 |
| | 22:33 | 6476 |
| | 22:36 | 6476 |
| | 22:39 | 6101 |
| | 22:42 | 6430 |
| | 23:01 | 6195 |
| | 23:04 | 6336 |
| | 23:07 | 6476 |
| | 23:10 | 6570 |
| | 23:13 | 6570 |
| | 23:16 | 6758 |
| | 23:19 | 6476 |
| | 23:22 | 6664 |
| | 23:25 | 6523 |
| | 23:28 | 6758 |
| | 23:31 | 5209 |
| | 23:34 | 6523 |
| | 23:37 | 6336 |
| | 23:40 | 6664 |
| | 23:43 | 6664 |
| | 23:46 | 6430 |
| | 23:49 | 6617 |
| | 23:52 | 6523 |
| | 23:55 | 6570 |
| | 23:58 | 6617 |
| 2/5/83 | 00:01 | 4177 |
| | 00:04 | 6805 |
| | 00:07 | 6570 |
| | 00:10 | 6523 |
| | 00:13 | 4693 |
| | 00:16 | 6617 |
| | 00:19 | 2112 |
| | 00:22 | 1267 |
| | 00:25 | 516 |
| | 00:28 | 375 |
| | 00:31 | 610 |
| | 00:34 | 610 |
| | 00:37 | 844 |
| | 00:40 | 4646 |
| | 00:43 | 5209 |
| | 00:46 | 5725 |
| | 00:49 | 6007 |
| | 00:52 | 4881 |
| | 00:55 | 6054 |
| | 00:58 | 5725 |
| | 01:01 | 5913 |
| | 01:04 | 5772 |
| | 01:07 | 6054 |
| | 01:10 | 5819 |
| | 01:13 | 5585 |
| | 01:16 | 5725 |
| | 01:19 | 4083 |
| | 01:22 | 5209 |
| | 01:25 | 5397 |
| | 01:28 | 5303 |
| | 01:31 | 5444 |
| | 01:34 | 5725 |
| 2/5/83 | 01:37 | 4975 |
| | 01:40 | 5115 |
| | 01:43 | 5491 |
| | 01:46 | 5444 |
| | 01:49 | 5772 |
| | 01:52 | 5913 |
| | 01:55 | 5819 |
| | 01:58 | 5913 |
| | 02:01 | 3989 |
| | 02:04 | 5491 |
| | 02:07 | 2158 |
| | 02:10 | 5162 |
| | 02:13 | 5632 |
| | 02:16 | 5819 |
| | 02:19 | 6195 |
| | 02:22 | 5913 |
| | 02:25 | 6289 |
| | 02:28 | 6242 |
| | 02:31 | 5960 |
| | 02:34 | 6007 |
| | 02:37 | 4364 |
| | 02:40 | 5679 |
| | 02:43 | 6148 |
| | 02:46 | 6007 |
| | 02:49 | 6383 |
| | 02:52 | 6054 |
| | 02:55 | 5772 |
| | 02:58 | 6195 |
| | 03:01 | 5209 |
| | 03:04 | 5866 |
| | 03:07 | 5819 |
| | 03:10 | 5913 |
| | 03:13 | 5303 |
| | 03:22 | 6242 |
| | 03:25 | 6523 |
| | 03:28 | 6336 |
| | 03:31 | 6758 |
| | 03:34 | 6805 |
| | 03:37 | 6899 |
| | 03:40 | 6054 |
| | 03:43 | 6993 |
| | 03:46 | 6852 |
| | 03:49 | 6617 |
| | 03:52 | 6852 |
| | 03:55 | 7040 |
| | 03:58 | 6711 |
| | 04:01 | 5772 |
| | 04:04 | 6711 |
| | 04:07 | 6805 |
| | 04:10 | 6758 |
| | 04:13 | 6993 |
| | 04:16 | 6899 |
| | 04:19 | 7040 |
| | 04:22 | 6805 |
| | 04:25 | 6054 |
| | 04:28 | 6711 |
| | 04:31 | 6617 |
| | 04:34 | 6711 |
| | 04:37 | 6664 |
| | 04:40 | 6617 |
| | 04:43 | 7040 |
| | 04:46 | 6664 |
| | 04:49 | 6523 |

## INLET NMHC CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/5/83 | 04:52 | 6711 |
| | 04:55 | 6852 |
| | 04:58 | 2909 |
| | 05:01 | 6007 |
| | 05:04 | 6336 |
| | 05:07 | 6289 |
| | 05:10 | 6430 |
| | 05:13 | 2581 |
| | 05:16 | 5444 |
| | 05:19 | 6289 |
| | 05:22 | 6242 |
| | 05:25 | 6805 |
| | 05:28 | 6758 |
| | 05:31 | 6476 |
| | 05:34 | 6664 |
| | 06:10 | 4740 |
| | 06:13 | 5350 |
| | 06:16 | 5491 |
| | 06:19 | 2816 |
| | 06:22 | 1689 |
| | 06:25 | 1079 |
| | 06:28 | 3520 |
| | 06:31 | 3238 |
| | 06:34 | 4975 |
| | 06:37 | 4928 |
| | 06:40 | 1877 |
| | 06:43 | 4552 |
| | 06:46 | 4599 |
| | 06:49 | 5256 |
| | 06:52 | 5585 |
| | 06:55 | 5772 |
| | 06:58 | 2675 |
| | 07:01 | 2018 |
| | 07:04 | 1454 |
| | 07:07 | 891 |
| | 07:10 | 3848 |
| | 07:13 | 4411 |
| | 07:16 | 4271 |
| | 07:19 | 4693 |
| | 07:22 | 4787 |
| | 07:25 | 5021 |
| | 07:28 | 5068 |
| | 07:31 | 4928 |
| | 07:34 | 5021 |
| | 07:37 | 5162 |
| | 07:40 | 5397 |
| | 07:43 | 5303 |
| | 07:46 | 4975 |
| | 07:49 | 5115 |
| | 07:52 | 4177 |
| | 07:55 | 4928 |
| | 07:58 | 5162 |
| | 08:01 | 5115 |
| | 08:04 | 4224 |
| | 08:07 | 4787 |

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/5/83 | 08:14 | 4975 |
| | 08:17 | 6148 |
| | 08:20 | 6617 |
| | 08:23 | 6664 |
| | 08:26 | 6383 |
| | 08:29 | 6758 |
| | 08:32 | 6336 |
| | 08:35 | 6617 |
| | 08:38 | 6758 |
| | 08:41 | 6805 |
| | 08:44 | 6758 |
| | 08:47 | 7087 |
| | 08:52 | 5397 |
| | 08:55 | 5538 |
| | 08:58 | 5538 |
| | 09:01 | 5538 |
| | 09:04 | 5491 |
| | 09:07 | 2956 |
| | 09:10 | 5068 |
| | 09:13 | 5444 |
| | 09:16 | 5115 |
| | 09:19 | 5350 |
| | 09:22 | 5068 |
| | 09:25 | 4224 |
| | 09:28 | 5256 |
| | 09:31 | 5068 |
| | 09:34 | 5115 |
| | 09:37 | 2862 |
| | 09:40 | 5209 |
| | 09:43 | 4881 |
| | 09:46 | 3989 |
| | 09:49 | 4881 |
| | 09:52 | 4928 |
| | 09:55 | 4975 |
| | 09:58 | 5021 |
| | 10:01 | 5162 |
| | 10:04 | 3238 |
| | 10:07 | 4787 |
| | 10:10 | 5068 |
| | 10:13 | 5162 |
| | 10:16 | 3801 |
| | 10:19 | 4787 |
| | 10:22 | 5068 |
| | 10:25 | 4787 |
| | 10:28 | 4881 |
| | 10:31 | 5021 |
| | 10:34 | 5021 |
| | 10:37 | 4458 |
| | 10:40 | 5162 |
| | 10:43 | 2065 |
| | 10:46 | 1454 |
| | 10:49 | 3050 |
| | 10:52 | 4177 |
| | 10:55 | 4411 |
| | 10:58 | 4740 |
| | 11:01 | 4693 |
| | 11:04 | 4975 |
| | 11:07 | 3995 |
| | 11:10 | 4928 |
| | 11:13 | 4928 |



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SECTION A.2

OUTLET CONCENTRATIONS

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## OUTLET THC CONCENTRATIONS

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 1/31/83 | 21:42 | 448 | 410 | 338 |
| | 21:45 | 352 | 424 | 414 |
| | 21:48 | 421 | 431 | 431 |
| | 21:51 | 424 | 410 | 424 |
| | 21:54 | 434 | 448 | 424 |
| | 21:57 | 427 | 427 | 427 |
| | 22:00 | 441 | 434 | 427 |
| | 22:03 | 427 | 434 | 427 |
| | 22:06 | 424 | 431 | 427 |
| | 22:09 | 317 | 158 | 434 |
| | 22:12 | 427 | 417 | 358 |
| | 22:15 | 396 | 424 | 421 |
| | 22:18 | 455 | 434 | 424 |
| | 22:21 | 431 | 441 | 414 |
| | 22:24 | 421 | 414 | 431 |
| | 22:27 | 424 | 414 | 421 |
| | 22:30 | 431 | 424 | 407 |
| | 22:33 | 414 | 427 | 200 |
| | 22:36 | 89.7 | 389 | 396 |
| | 22:39 | 417 | 427 | 421 |
| | 22:42 | 421 | 403 | 414 |
| | 22:45 | 421 | 410 | 414 |
| | 22:48 | 427 | 431 | 431 |
| | 22:51 | 403 | 414 | 427 |
| | 22:54 | 393 | | |
| 2/1/83 | 07:27 | 434 | 445 | 448 |
| | 07:30 | 448 | 445 | 434 |
| | 07:33 | 124 | 355 | 400 |
| | 07:36 | 400 | 421 | 421 |
| | 07:39 | 417 | 396 | 396 |
| | 07:42 | 396 | 410 | 403 |
| | 07:45 | 424 | 410 | 427 |
| | 07:48 | 376 | 427 | 407 |
| | 07:51 | 403 | 421 | 393 |
| | 07:54 | 424 | 148 | 144 |
| | 07:57 | 372 | 389 | 400 |
| | 08:00 | 158 | 400 | 372 |
| | 08:03 | 396 | 403 | 400 |
| | 08:06 | 383 | 383 | 427 |
| | 08:09 | 424 | 403 | 396 |

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/1/83 | 19:31 | 377 | 283 | 162 |
| | 19:34 | 377 | 389 | 181 |
| | 19:37 | 113 | 147 | 98.2 |
| | 19:40 | 98.2 | 90.6 | 105 |
| | 19:43 | 79.3 | 98.2 | 105 |
| | 19:46 | 109 | 105 | 324 |
| | 19:49 | 396 | 373 | 362 |
| | 19:52 | 392 | 362 | 385 |
| | 19:55 | 392 | 419 | 411 |
| | 19:58 | 438 | 407 | 177 |
| | 20:01 | 139 | 298 | 430 |
| | 20:04 | 453 | 472 | 430 |
| | 20:07 | 445 | 438 | 453 |
| | 20:10 | 464 | 162 | 128 |
| | 20:13 | 105 | 86.8 | 98.2 |
| | 20:16 | 343 | 426 | 449 |
| | 20:19 | 457 | 460 | 457 |
| | 20:22 | 468 | 460 | 472 |
| | 20:25 | 441 | 256 | 113 |
| | 20:28 | 86.8 | 94.4 | 90.6 |
| | 20:31 | 105 | 98.2 | 86.8 |
| | 20:34 | 79.3 | 67.9 | 75.5 |
| | 20:37 | 90.6 | 71.7 | 75.5 |
| | 20:40 | 75.5 | 90.6 | 120 |
| | 20:43 | 105 | 400 | 438 |
| | 20:46 | 328 | 128 | 113 |
| | 20:49 | 98.2 | 105 | 79.3 |
| | 20:52 | 60.4 | 113 | 90.6 |
| | 20:55 | 177 | 128 | 290 |
| | 20:58 | 392 | 419 | 207 |
| | 21:01 | 249 | 392 | 426 |
| 2/3/83 | 13:00 | 614 | 214 | 599 |
| | 13:03 | 570 | 570 | 607 |
| | 13:06 | 570 | 599 | 555 |
| | 13:09 | 570 | 584 | 577 |
| | 13:12 | 599 | 584 | 584 |
| | 13:15 | 621 | 607 | 607 |
| | 13:18 | 614 | 607 | 599 |
| | 13:21 | 614 | 614 | 599 |
| | 13:24 | 599 | 607 | 614 |
| | 13:27 | 607 | 607 | 599 |
| | 13:30 | 547 | 318 | 629 |
| | 13:33 | 592 | 599 | 607 |
| | 13:36 | 614 | 584 | 607 |
| | 13:39 | 607 | 651 | 584 |
| | 13:42 | 636 | 621 | 614 |
| | 13:45 | 599 | 599 | 599 |
| | 13:48 | 621 | 614 | 584 |
| | 13:51 | 599 | 629 | 644 |
| | 13:54 | 584 | 584 | 621 |
| | 13:57 | 592 | 384 | 310 |

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## OUTLET THC CONCENTRATIONS

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/3/83 | 14:00 | 599 | 584 | 140 |
| | 14:03 | 96.2 | 103 | 599 |
| | 14:06 | 577 | 599 | 584 |
| | 14:09 | 614 | 629 | 607 |
| | 14:12 | 577 | 607 | 584 |
| | 14:15 | 599 | 555 | 599 |
| | 14:18 | 599 | 599 | 584 |
| | 14:21 | 570 | 555 | 577 |
| | 14:24 | 607 | 599 | 629 |
| | 14:27 | 614 | 607 | 614 |
| | 14:30 | 570 | 584 | 599 |
| | 14:33 | 584 | 607 | 577 |
| | 14:36 | 607 | 503 | 533 |
| | 14:39 | 577 | 614 | 636 |
| | 14:42 | 621 | 599 | 636 |
| | 14:45 | 621 | 673 | 621 |
| | 14:48 | 636 | 629 | 621 |
| | 14:51 | 636 | 629 | 614 |
| | 14:54 | 621 | 629 | 621 |
| | 14:57 | 621 | 621 | 614 |
| | 15:00 | 644 | 614 | 614 |
| | 15:03 | 629 | 621 | 644 |
| | 15:06 | 599 | 607 | 614 |
| | 15:09 | 614 | 421 | 651 |
| | 15:12 | 636 | 673 | 666 |
| | | | | |
| | 16:53 | 596 | 603 | 610 |
| | 16:56 | 603 | 596 | 596 |
| | 16:59 | 577 | 588 | 603 |
| | 17:02 | 621 | 636 | 640 |
| | 17:05 | 618 | 633 | 636 |
| | 17:08 | 621 | 610 | 614 |
| | 17:11 | 618 | 633 | 614 |
| | 17:14 | 599 | 596 | 618 |
| | 17:17 | 603 | 610 | 618 |
| | 17:20 | 629 | 629 | 618 |
| | 17:23 | 618 | 636 | 636 |
| | 17:26 | 629 | 621 | 618 |
| | 17:29 | 618 | 596 | 599 |
| | 17:32 | 599 | 603 | 607 |
| | 17:35 | 314 | 614 | 618 |
| | 17:38 | 618 | 621 | 603 |
| | 17:41 | 629 | 603 | 629 |
| | 17:44 | 629 | 618 | 596 |
| | 17:47 | 596 | 588 | 618 |
| | 17:50 | 596 | 596 | 333 |
| | 17:53 | 559 | 584 | 596 |
| | 17:56 | 618 | 610 | 614 |
| | 17:59 | 618 | 614 | 614 |
| | 18:02 | 614 | 599 | 614 |
| | 18:05 | 621 | 614 | 596 |
| | 18:08 | 618 | 610 | 618 |
| | 18:11 | 658 | 633 | 614 |
| | 18:14 | 610 | 621 | 607 |

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/3/83 | 18:17 | 621 | 647 | 670 |
| | 18:20 | 662 | 662 | 655 |
| | 18:23 | 662 | 310 | 629 |
| | 18:26 | 633 | 640 | 636 |
| | 18:29 | 647 | 662 | 658 |
| | 18:32 | 636 | 640 | 633 |
| | 18:35 | 640 | 636 | 655 |
| | 18:38 | 640 | 655 | 655 |
| | 18:41 | 666 | 655 | 655 |
| | 18:44 | 655 | 199 | 629 |
| | 18:47 | 618 | 633 | 636 |
| | 18:50 | 633 | 610 | 629 |
| | 18:53 | 636 | 640 | 651 |
| | 18:56 | 636 | 636 | 640 |
| | 18:59 | 618 | 629 | 610 |
| | 19:02 | 629 | 633 | 629 |
| | 19:05 | 610 | 655 | 651 |
| | 19:08 | 651 | 651 | 658 |
| | 19:11 | 651 | 677 | |
| | | | | |
| | 20:53 | 525 | 533 | 551 |
| | 20:56 | 536 | 533 | 559 |
| | 20:59 | 551 | 562 | 566 |
| | 21:02 | 562 | 577 | 577 |
| | 21:05 | 592 | 584 | 596 |
| | 21:08 | 588 | 584 | 584 |
| | 21:11 | 621 | 236 | 455 |
| | 21:14 | 599 | 614 | 581 |
| | 21:17 | 618 | 136 | 96.1 |
| | 21:20 | 122 | 581 | 577 |
| | 21:23 | 599 | 288 | 481 |
| | 21:26 | 525 | 559 | 559 |
| | 21:29 | 577 | 570 | 584 |
| | 21:32 | 551 | 577 | 633 |
| | 21:35 | 629 | 599 | 177 |
| | 21:38 | 118 | 103 | 96.2 |
| | 21:41 | 596 | 610 | 610 |
| | 21:44 | 599 | 584 | 618 |
| | 21:47 | 614 | 614 | 636 |
| | 21:50 | 633 | 629 | 636 |
| | 21:53 | 633 | 621 | 621 |
| | 21:56 | 633 | 640 | 629 |
| | 21:59 | 651 | 251 | 551 |
| | 22:02 | 618 | 629 | 636 |
| | 22:05 | 614 | 633 | 640 |
| | 22:08 | 647 | 636 | 636 |
| | 22:11 | 607 | 629 | 629 |
| | 22:14 | 640 | 633 | 614 |
| | 22:17 | 633 | 640 | 640 |
| | 22:20 | 640 | 277 | 607 |
| | 22:23 | 651 | 633 | 614 |
| | 22:26 | 610 | 629 | 618 |
| | 22:29 | 640 | 629 | 633 |
| | 22:32 | 621 | 633 | 629 |
| | 22:35 | 636 | 629 | 640 |
| | 22:38 | 640 | 633 | 651 |
| | 22:41 | 251 | 251 | 614 |
| | 22:44 | 640 | 655 | 629 |
| | 22:47 | 621 | 636 | 644 |
| | 22:50 | 647 | 636 | 614 |
| | 22:53 | 640 | 636 | 647 |
| | 22:56 | 633 | 618 | 651 |
| | 22:59 | 640 | 640 | 651 |
| | 23:02 | 229 | | |

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## OUTLET THC CONCENTRATIONS

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/4/83 | 10:17 | 555 | 536 | 533 |
| | 10:20 | 551 | 555 | 562 |
| | 10:23 | 559 | 536 | 551 |
| | 10:26 | 566 | 540 | 559 |
| | 10:29 | 551 | 540 | 544 |
| | 10:32 | 566 | 555 | 566 |
| | 10:35 | 559 | 544 | 544 |
| | 10:38 | 559 | 544 | 551 |
| | 10:41 | 125 | 373 | 544 |
| | 10:44 | 570 | 559 | 566 |
| | 10:47 | 573 | 540 | 540 |
| | 10:50 | 584 | 570 | 555 |
| | 10:53 | 577 | 577 | 566 |
| | 10:56 | 573 | 559 | 359 |
| | 10:59 | 540 | 570 | 584 |
| | 11:02 | 577 | 562 | 584 |
| | 11:05 | 577 | 577 | 562 |
| | 11:08 | 555 | 566 | 566 |
| | 11:11 | 555 | 555 | 577 |
| | 11:14 | 573 | 570 | 559 |
| | 11:17 | 566 | | |
| | 12:10 | | 344 | 559 |
| | 12:13 | 581 | 566 | 536 |
| | 12:16 | 318 | 566 | 584 |
| | 12:19 | 566 | 559 | 588 |
| | 12:22 | 596 | | |
| | 14:40 | 473 | 488 | 459 |
| | 14:43 | 470 | 492 | 510 |
| | 14:46 | 481 | 503 | 522 |
| | 14:49 | 499 | 510 | 492 |
| | 14:52 | 503 | 525 | 488 |
| | 14:55 | 536 | 525 | 507 |
| | 14:58 | 540 | 503 | 525 |
| | 15:01 | 525 | 510 | 540 |
| | 15:04 | 136 | 88.8 | 55.5 |
| | 15:07 | 70.3 | 285 | 488 |
| | 15:10 | 118 | 122 | 455 |
| | 15:13 | 518 | 525 | 522 |
| | 15:16 | 525 | 522 | 544 |
| | 15:19 | 566 | 551 | 566 |
| | 15:22 | 559 | 536 | 551 |
| | 15:25 | 192 | 96.2 | 74 |
| | 15:28 | 59.2 | 59.2 | 55.5 |
| | 15:31 | 51.8 | 44.4 | 299 |
| | 15:34 | 525 | 525 | 559 |
| | 15:37 | 540 | 533 | 559 |
| | 15:40 | 129 | 551 | 540 |
| | 15:43 | 492 | 140 | 525 |
| | 15:46 | 559 | 588 | 136 |
| | 15:49 | 559 | 562 | 562 |
| | 15:52 | 607 | 577 | 577 |
| | 15:55 | 551 | 577 | 577 |
| | 15:58 | 559 | 584 | 570 |
| | 16:01 | 559 | 592 | 581 |
| | 16:04 | 607 | 640 | 633 |
| | 16:07 | 629 | 666 | 610 |

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/4/83 | 16:10 | 614 | 618 | 607 |
| | 16:13 | 640 | 273 | 551 |
| | 16:16 | 285 | 129 | 551 |
| | 16:19 | 621 | 599 | 610 |
| | 16:22 | 621 | 596 | 633 |
| | 16:25 | 621 | 614 | 655 |
| | 16:28 | 621 | 636 | 599 |
| | 16:31 | 640 | 614 | 640 |
| | 16:34 | 607 | 633 | 599 |
| | 16:37 | 618 | 618 | 629 |
| | 16:40 | 633 | 610 | 377 |
| | 16:43 | 151 | 610 | 596 |
| | 16:46 | 618 | 610 | 607 |
| | 16:49 | 607 | 588 | 636 |
| | 16:52 | 596 | 592 | 610 |
| | 16:55 | 607 | 588 | 614 |
| | 16:58 | 455 | 140 | 96.2 |
| | 17:01 | 551 | 599 | 610 |
| | 17:04 | 633 | 596 | 592 |
| | 17:07 | 581 | 607 | 592 |
| | 17:10 | 618 | 444 | |
| | 18:25 | 459 | 429 | 481 |
| | 18:28 | 544 | 518 | 525 |
| | 18:31 | 559 | 533 | 525 |
| | 18:34 | 555 | 559 | 436 |
| | 18:37 | 107 | 525 | 536 |
| | 18:40 | 581 | 559 | 540 |
| | 18:43 | 555 | 70.3 | 555 |
| | 18:46 | 551 | 570 | 551 |
| | 18:49 | 555 | 581 | 551 |
| | 18:52 | 584 | 540 | 581 |
| | 18:55 | 299 | 577 | 544 |
| | 18:58 | 577 | 536 | 555 |
| | 19:01 | 581 | 544 | 559 |
| | 19:04 | 562 | 125 | 92.5 |
| | 19:07 | 62.9 | 444 | 540 |
| | 19:10 | 559 | 559 | 551 |
| | 19:13 | 581 | 581 | 544 |
| | 19:16 | 573 | 570 | 551 |
| | 19:19 | 584 | 573 | 544 |
| | 19:22 | 588 | 559 | 566 |
| | 19:25 | 581 | 551 | 584 |
| | 19:28 | 592 | 151 | 181 |
| | 19:31 | 499 | 555 | 559 |
| | 19:34 | 555 | 573 | 596 |
| | 19:37 | 536 | 577 | 559 |
| | 19:40 | 562 | 588 | 584 |
| | 19:43 | 559 | 588 | 584 |
| | 19:46 | 555 | 577 | 566 |
| | 19:49 | 559 | 588 | 551 |
| | 19:52 | 562 | 584 | 551 |
| | 19:55 | 559 | 581 | 581 |
| | 19:58 | 581 | 544 | 566 |
| | 20:01 | 299 | 559 | 588 |
| | 20:04 | 562 | 584 | 562 |
| | 20:07 | 562 | 592 | 570 |
| | 20:10 | 577 | 592 | 551 |
| | 20:13 | 581 | 596 | 566 |

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## OUTLET THC CONCENTRATIONS

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/4/83 | 20:16 | 596 | 581 | 588 |
| | 20:19 | 610 | 555 | 614 |
| | 20:22 | 570 | 588 | 592 |
| | 20:25 | 551 | 584 | 584 |
| | 20:28 | 562 | 596 | 551 |
| | 20:31 | 425 | 240 | 540 |
| | 20:34 | 577 | 566 | 562 |
| | 20:37 | 362 | 562 | 562 |
| | 20:40 | 555 | 570 | 584 |
| | 20:43 | 559 | 584 | 559 |
| | 20:46 | 525 | 488 | 440 |
| | 20:49 | 403 | 562 | 525 |
| | 20:52 | 522 | 536 | 525 |
| | 20:55 | 544 | 559 | 551 |
| | 20:58 | 533 | 544 | 536 |
| | 21:01 | 522 | 455 | 129 |
| | 21:04 | 111 | 151 | 425 |
| | 21:07 | 473 | 484 | 481 |
| | 21:10 | 455 | 470 | 447 |
| | 21:13 | 414 | 422 | 399 |
| | 21:16 | 418 | 444 | 447 |
| | 21:19 | 470 | 481 | 499 |
| | 21:22 | 481 | 462 | 444 |
| | 21:25 | 440 | 414 | 410 |
| | 21:28 | 414 | 418 | 444 |
| | 21:31 | 459 | 484 | 499 |
| | 21:34 | 470 | 273 | 455 |
| | 21:37 | 455 | 447 | 418 |
| | 21:40 | 388 | 407 | 403 |
| | 21:43 | 444 | 440 | 462 |
| | 21:46 | 492 | 484 | 484 |
| | 21:49 | 459 | 444 | 418 |
| | 21:52 | 425 | 418 | 447 |
| | 21:55 | 455 | 492 | 484 |
| | 21:58 | 473 | 462 | 418 |
| | 22:01 | 418 | 418 | 436 |
| | 22:04 | 455 | 499 | 162 |
| | 22:07 | 462 | 429 | 388 |
| | 22:10 | 414 | 407 | 455 |
| | 22:13 | 481 | 462 | 444 |
| | 23:01 | 425 | 470 | 429 |
| | 23:04 | 440 | 429 | 436 |
| | 23:07 | 429 | 422 | 447 |
| | 23:10 | 436 | 440 | 436 |
| | 23:13 | 425 | 440 | 455 |
| | 23:16 | 418 | 422 | 436 |
| | 23:19 | 418 | 447 | 440 |
| | 23:22 | 455 | 440 | 440 |
| | 23:25 | 429 | 425 | 455 |
| | 23:28 | 422 | 422 | 166 |
| | 23:31 | 414 | 459 | 440 |
| | 23:34 | 436 | 447 | 436 |
| | 23:37 | 444 | 447 | 444 |
| | 23:40 | 436 | 436 | 414 |
| | 23:43 | 459 | 440 | 429 |
| | 23:46 | 440 | 436 | 444 |
| | 23:49 | 414 | 447 | 455 |
| | 23:52 | 455 | 447 | 436 |
| | 23:55 | 422 | 462 | 440 |
| | 23:58 | 429 | 436 | 444 |

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/5/83 | 00:01 | 181 | 425 | 447 |
| | 00:04 | 462 | 436 | 447 |
| | 00:07 | 455 | 440 | 436 |
| | 00:10 | 447 | 440 | 440 |
| | 00:13 | 148 | 436 | 455 |
| | 00:16 | 455 | 266 | 111 |
| | 00:19 | 92.5 | 88.8 | 81.4 |
| | 00:22 | 74 | 88.8 | 66.6 |
| | 00:25 | 66.6 | 66.6 | 66.6 |
| | 00:28 | 70.3 | 85.1 | 81.4 |
| | 00:31 | 74 | 66.6 | 81.4 |
| | 00:34 | 59.2 | 355 | 81.4 |
| | 00:37 | 62.9 | 207 | 366 |
| | 00:40 | 385 | 396 | 392 |
| | 00:43 | 399 | 410 | 410 |
| | 00:46 | 414 | 407 | 418 |
| | 00:49 | 414 | 396 | 377 |
| | 00:52 | 144 | 425 | 436 |
| | 00:55 | 447 | 399 | 381 |
| | 00:58 | 348 | 362 | 392 |
| | 01:01 | 410 | 440 | 436 |
| | 01:04 | 429 | 385 | 381 |
| | 01:07 | 362 | 396 | 410 |
| | 01:10 | 422 | 440 | 481 |
| | 01:13 | 522 | 425 | 507 |
| | 01:16 | 447 | 148 | 144 |
| | 01:19 | 499 | 481 | 559 |
| | 01:22 | 510 | 525 | 507 |
| | 01:25 | 555 | 522 | 362 |
| | 01:28 | 559 | 536 | 544 |
| | 01:31 | 555 | 559 | 544 |
| | 01:34 | 559 | 559 | 544 |
| | 01:37 | 259 | 177 | 544 |
| | 01:40 | 562 | 559 | 555 |
| | 01:43 | 573 | 566 | 562 |
| | 01:46 | 559 | 566 | 581 |
| | 01:49 | 566 | 577 | 573 |
| | 01:52 | 573 | 573 | 618 |
| | 01:55 | 584 | 599 | 599 |
| | 01:58 | 584 | 607 | 584 |
| | 02:01 | 211 | 559 | 584 |
| | 02:04 | 625 | 599 | 170 |
| | 02:07 | 136 | 151 | 577 |
| | 02:10 | 599 | 596 | 625 |
| | 02:13 | 618 | 633 | 614 |
| | 02:16 | 640 | 636 | 633 |
| | 02:19 | 644 | 644 | 629 |
| | 02:22 | 636 | 636 | 647 |
| | 02:25 | 640 | 636 | 644 |
| | 02:28 | 640 | 640 | 618 |
| | 02:31 | 658 | 647 | 633 |
| | 02:34 | 651 | 666 | 651 |
| | 02:37 | 203 | 596 | 647 |
| | 02:40 | 629 | 633 | 647 |
| | 02:43 | 655 | 666 | 636 |
| | 02:46 | 647 | 658 | 651 |
| | 02:49 | 651 | 662 | 662 |
| | 02:52 | 640 | 636 | 658 |
| | 02:55 | 644 | 647 | 658 |
| | 02:58 | 592 | 188 | 455 |
| | 03:01 | 614 | 633 | 636 |
| | 03:04 | 647 | 651 | 636 |
| | 03:07 | 633 | 647 | 633 |
| | 03:10 | 640 | 559 | |

## OUTLET THC CONCENTRATIONS

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/5/83 | 03:19 | 651 | 684 | 688 |
| | 03:22 | 696 | 703 | 696 |
| | 03:25 | 714 | 681 | 707 |
| | 03:28 | 703 | 710 | 710 |
| | 03:31 | 714 | 721 | 707 |
| | 03:34 | 721 | 703 | 733 |
| | 03:37 | 710 | 566 | 658 |
| | 03:40 | 710 | 692 | 696 |
| | 03:43 | 710 | 710 | 710 |
| | 03:46 | 714 | 703 | 725 |
| | 03:49 | 729 | 710 | 736 |
| | 03:52 | 740 | 721 | 729 |
| | 03:55 | 721 | 725 | 703 |
| | 03:58 | 721 | 725 | 696 |
| | 04:01 | 255 | 677 | 707 |
| | 04:04 | 718 | 714 | 729 |
| | 04:07 | 721 | 733 | 725 |
| | 04:10 | 721 | 733 | 733 |
| | 04:13 | 725 | 762 | 744 |
| | 04:16 | 721 | 725 | 721 |
| | 04:19 | 736 | 721 | 729 |
| | 04:22 | 733 | 662 | 559 |
| | 04:25 | 696 | 729 | 725 |
| | 04:28 | 707 | 710 | 733 |
| | 04:31 | 710 | 736 | 725 |
| | 04:34 | 733 | 714 | 725 |
| | 04:37 | 707 | 733 | 744 |
| | 04:40 | 740 | 747 | 758 |
| | 04:43 | 733 | 740 | 737 |
| | 04:46 | 318 | 677 | 736 |
| | 04:49 | 733 | 725 | 729 |
| | 04:52 | 733 | 744 | 751 |
| | 04:55 | 733 | 240 | 159 |
| | 04:58 | 444 | 688 | 714 |
| | 05:01 | 714 | 721 | 733 |
| | 05:04 | 707 | 733 | 736 |
| | 05:07 | 710 | 710 | 714 |
| | 05:10 | 729 | 573 | 199 |
| | 05:13 | 170 | 303 | 584 |
| | 05:16 | 688 | 707 | 707 |
| | 05:19 | 692 | 729 | 729 |
| | 05:22 | 707 | 710 | 740 |
| | 05:25 | 721 | 729 | 725 |
| | 05:28 | 725 | 725 | 740 |
| | 05:31 | 714 | 744 | 725 |
| | 05:34 | 725 | 710 | 644 |
| | 06:10 | 577 | 610 | 610 |
| | 06:13 | 599 | 614 | 629 |
| | 06:16 | 607 | 625 | 207 |
| | 06:19 | 140 | 122 | 92.5 |
| | 06:22 | 70.3 | 74 | 70.3 |
| | 06:25 | 74 | 66.6 | 484 |
| | 06:28 | 592 | 584 | 207 |
| | 06:31 | 577 | 592 | 610 |
| | 06:34 | 299 | 577 | 614 |
| | 06:37 | 525 | 144 | 122 |
| | 06:40 | 92.5 | 536 | 592 |
| | 06:43 | 614 | 507 | 555 |
| | 06:46 | 610 | 618 | 610 |

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/5/83 | 06:49 | 618 | 636 | 633 |
| | 06:52 | 647 | 614 | 666 |
| | 06:55 | 636 | 633 | 199 |
| | 06:58 | 140 | 111 | 88.8 |
| | 07:01 | 418 | 140 | 118 |
| | 07:04 | 103 | 86.8 | 85.1 |
| | 07:07 | 81.4 | 203 | 533 |
| | 07:10 | 536 | 533 | 540 |
| | 07:13 | 444 | 307 | 533 |
| | 07:16 | 551 | 551 | 544 |
| | 07:19 | 562 | 559 | 551 |
| | 07:22 | 562 | 555 | 566 |
| | 07:25 | 559 | 566 | 573 |
| | 07:28 | 573 | 562 | 577 |
| | 07:31 | 592 | 188 | 555 |
| | 07:34 | 562 | 573 | 573 |
| | 07:37 | 581 | 584 | 581 |
| | 07:40 | 592 | 577 | 573 |
| | 07:43 | 577 | 596 | 577 |
| | 07:46 | 584 | 596 | 610 |
| | 07:49 | 588 | 270 | 199 |
| | 07:52 | 573 | 566 | 573 |
| | 07:55 | 566 | 577 | 607 |
| | 07:58 | 599 | 566 | 592 |
| | 08:01 | 581 | 592 | 584 |
| | 08:04 | 185 | 129 | 544 |
| | 08:07 | 566 | 573 | 581 |
| | 08:52 | 625 | 610 | 592 |
| | 08:55 | 599 | 610 | 614 |
| | 08:58 | 614 | 607 | 607 |
| | 09:01 | 607 | 596 | 592 |
| | 09:04 | 610 | 614 | 266 |
| | 09:07 | 307 | 577 | 566 |
| | 09:10 | 596 | 610 | 584 |
| | 09:13 | 596 | 592 | 584 |
| | 09:16 | 584 | 596 | 584 |
| | 09:19 | 607 | 607 | 584 |
| | 09:22 | 596 | 614 | 584 |
| | 09:25 | 185 | 562 | 562 |
| | 09:28 | 577 | 581 | 592 |
| | 09:31 | 592 | 581 | 592 |
| | 09:34 | 592 | 584 | 222 |
| | 09:37 | 455 | 566 | 573 |
| | 09:40 | 581 | 573 | 592 |
| | 09:43 | 581 | 385 | 203 |
| | 09:46 | 559 | 559 | 588 |
| | 09:49 | 577 | 581 | 588 |
| | 09:52 | 592 | 577 | 584 |
| | 09:55 | 592 | 566 | 596 |
| | 09:58 | 599 | 596 | 573 |
| | 10:01 | 581 | 584 | 211 |
| | 10:04 | 522 | 584 | 573 |
| | 10:07 | 577 | 592 | 607 |
| | 10:10 | 592 | 577 | 592 |
| | 10:13 | 566 | 588 | 377 |
| | 10:16 | 525 | 584 | 592 |
| | 10:19 | 573 | 577 | 573 |
| | 10:22 | 359 | 385 | 559 |
| | 10:25 | 577 | 562 | 596 |
| | 10:28 | 592 | 566 | 610 |
| | 10:31 | 607 | 581 | 592 |

## OUTLET THC CONCENTRATIONS

| Date | Sample End Time | Concentrations (ppmv) at one minute intervals | | |
|---|---|---|---|---|
| 2/5/83 | 10:34 | 596 | 588 | 407 |
| | 10:37 | 584 | 588 | 596 |
| | 10:40 | 599 | 166 | 92.5 |
| | 10:43 | 88.8 | 66.6 | 66.6 |
| | 10:46 | 55.5 | 103 | 299 |
| | 10:49 | 536 | 562 | 566 |
| | 10:52 | 584 | 551 | 566 |
| | 10:55 | 562 | 566 | 592 |
| | 10:58 | 577 | 581 | 551 |
| | 11:01 | 592 | 581 | 573 |
| | 11:04 | 185 | 544 | 540 |
| | 11:07 | 322 | 581 | 566 |
| | 11:10 | 562 | 584 | 607 |
| | 11:13 | 577 | 562 | 584 |

OUTLET FULL-SCAN THC CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/2/83 | 08;24 | 460 |
| 2/3/83 | 15;33 | 621 |
| | 16;10 | 592 |
| | 16;34 | 592 |
| | 16;46 | 633 |
| 2/4/83 | 22;30 | 444 |
| | 22;42 | 436 |
| 2/5/83 | 08;23 | 584 |
| | 08;35 | 729 |
| | 08;47 | 744 |

OUTLET FULL-SCAN CO CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/2/83 | 08;24 | 63.1 |
| 2/3/83 | 15;33 | 35.4 |
| | 16;10 | 37.1 |
| | 16;34 | 33.1 |
| | 16;46 | 37.7 |
| 2/4/83 | 22;30 | 27 |
| | 22;42 | 26.4 |
| 2/5/83 | 08;23 | 14.8 |
| | 08;35 | 20.3 |
| | 08;47 | 20.9 |

OUTLET FULL-SCAN $CH_4$ CONCENTRATIONS

| Date | Sample End Time | Concentration (ppmv) |
|---|---|---|
| 2/2/83 | 08;24 | 28.2 |
| 2/3/83 | 15;33 | 25.7 |
| | 16;10 | 26.9 |
| | 16;34 | 25.7 |
| | 16;46 | 26.5 |
| 2/4/83 | 22;30 | 23.4 |
| | 22;42 | 22.5 |
| 2/5/83 | 08;23 | 23.4 |
| | 08;35 | 25.5 |
| | 08;47 | 25.5 |

## APPENDIX B

## STACK GAS MOISTURE CONTENT AND VOLUMETRIC FLOWRATE

The results of moisture content and volumetric flowrate measurements performed on the incinerator exhaust stack at Plant C-4 are summarized in Tables B-1 and B-2. Results shown in the tables were measured according to EPA Methods 1, 2, and 4.

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TABLE B-1. RESULTS OF STACK GAS MOISTURE CONTENT MEASUREMENTS AT PLANT C-4

| Run # | Date | Start Time | Stack Gas Moisture Content (%) |
|---|---|---|---|
| 1 | 2-2-83 | 1509 | 5.13 |
| 2 | 2-4-83 | 1621 | 5.50 |
| 3 | 2-5-83 | 1012 | 5.51 |

TABLE B-2. RESULTS OF STACK GAS VOLUMETRIC FLOWRATE MEASUREMENTS AT PLANT C-4

| Run # | Date | Start Time | Volumetric Gas Flowrate $dNm^3/sec$ (dscfm) | Average Stack Gas Temperature °C (°F) |
|---|---|---|---|---|
| 1 | 2-1-83 | 1558 | 3.41 (7230)[a] | 352 (666) |
| 2 | 2-4-83 | 1220 | 2.61 (5530)[b] | 342 (648) |
| 3 | 2-4-83 | 1455 | 2.39 (5056)[c] | 398 (748) |
| 4 | 2-4-83 | 1543 | 2.48 (5250) | 417 (782) |
| 5 | 2-4-83 | 1844 | 2.65 (5620) | 420 (788) |
| 6 | 2-4-83 | 2148 | 2.88 (6100) | 436 (816) |
| 7 | 2-5-83 | 0930 | 2.73 (5790) | 364 (688) |

[a]Preliminary run; results not used in determining average flowrate from stack.

[b]Only one axis traversed; plant was up and down.

[c]Plant down at end of run.

# APPENDIX C

## GC RESULTS

The results of GC analyses for Products A and B are presented in Tables C-1 and C-2. Compound identifications were assigned to some of the sample peaks based on comparison of retention times against known standards.

TABLE C-1. RESULTS OF HYDROCARBON SPECIATION FOR PRODUCT A

| | | Method 18 Concentration (ppmv-C)[a] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Retention Time+ | $C_5$-$C_6$ | $C_6$-$C_7$ | | | | $C_7$+ | | | | | |
| | | 5.90 | 10.0 | 10.5 | 13.25 | Σ Others | 15.70 | 16.9 | 20.4 | 22.7 | 24.1 | |
| Date | Time | | MIBK | | | | | Ethyl Benzene | | | | THC |
| | | | | | | Inlet | | | | | | |
| 1-31-83 | 2030 | 518 | 351 | 437 | 26.4 | 41.0 | 6.81 | 533 | 1369 | 310 | 428 | 4020 |
| | 2123 | 508 | 330 | 386 | 28.2 | 42.1 | 16.3 | 486 | 1199 | 290 | 390 | 3676 |
| 2-1-83 | 1603 | 490 | 291 | 404 | 18.4 | 30.4 | 3.8 | 507 | 1273 | 312 | 405 | 3735 |
| | 1648 | 503 | 314 | 393 | 17.9 | 32.6 | ND[b] | 488 | 1221 | 295 | 379 | 3644 |
| | | 505±12 | 322±25 | 405±23 | 22.7±5.3 | 36.5±5.9 | 8.97±6.52 | 504±22 | 1266±77 | 302±11 | 401±21 | 3769±172 |
| | | | | | | Outlet | | | | | | |
| 1-31-83 | 2215 | ND | 45.1 | ND | ND | ND | ND | 33.2 | 66.3 | 12 | 12 | 170 |
| 2-1-83 | 0815 | ND | 20.0 | ND | ND | ND | ND | 28.5 | 59.5 | 10 | 10 | 128 |
| | | | 32.6±17.7 | | | | | 30.9±3.3 | 62.9±4.8 | ∿11±∿1 | ∿11±∿1 | 149±30 |

[a] ppmv-C = parts per million by volume as carbon quantitated against propane.

[b] ND = not detected. Detection limit is 3.0 ppmv-C.

TABLE C-2. RESULTS OF HYDROCARBON SPECIATION FOR PRODUCT B

| | | Method 18 Concentration (ppmv-C)[a] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Retention Time→ | $C_3$ | $C_4$ | | $C_5$-$C_6$ | | $C_6$-$C_7$ | | $C^{7+}$ | | | | | |
| | | 2.5 | 3.3 | 5.5 | 6.3 | 7.3 | 9.7 | 12.4 | 15.7 | 18.0 | 22.4 | 24.4 | 26.2 | |
| Date | Time | | | | | | MIBK | Toluene | | Ethyl Benzene | Xylene | Xylene | | THC |
| | | | | | | | **Inlet** | | | | | | | |
| 2-3-83 | 1256 | ND[b] | ND | 5.0 | 90.8 | 668 | 1834 | 58.2 | 117 | 60.0 | 201 | 52.6 | 48.3 | 3130 |
| | 1345 | ND | ND | 4.76 | 103 | 742 | 1885 | 739 | 133 | 59.1 | 160 | 71.3 | 61.0 | 3293 |
| | 1435 | ND | ND | 2.5 | 29.1 | 108 | 948 | 27.0 | 9.89 | 33.6 | 71.8 | 15 | 15 | 1258 |
| | 1513 | ND | ND | 4.27 | 111 | 769 | 1918 | 77.9 | 141 | 60.6 | 200 | 55.4 | 53.5 | 3390 |
| | 1629 | ND | ND | 2.79 | 103 | 724 | 1843 | 76.3 | 146 | 57.8 | 159 | 70.1 | 58.9 | 3241 |
| 2-4-83 | 1153 | ND | ND | ND | ND | ND | 29.9 | ND | ND | ND | ND | ND | ND | 29.9 |
| | 1453 | ND | ND | 2.1 | 87.0 | 645 | 1786 | 72.3 | 180 | 66.3 | 173 | 56 | 56 | 3121 |
| | 1655 | ND | ND | 5.6 | 147 | 864 | 2236 | 95.9 | 196 | 72.5 | 245 | 67.1 | 64.6 | 3994 |
| | 2114 | ND | ND | 5.6 | 113 | 736 | 1884 | 88.0 | 180 | 59.2 | 197 | 54.1 | 50.8 | 3368 |
| | 2152 | ND | ND | 4.20 | 120 | 776 | 1991 | 84.9 | 173 | 57.7 | 201 | 53.0 | 50.2 | 3511 |
| 2-5-83 | 1010 | ND | ND | 2.8 | 95 | 636 | 1602 | ←——— | | 683[c] | | | ———→ | 3019 |
| | | | | | | | **Outlet** | | | | | | | |
| 2-1-83 | 2057 | ND | ND | ND | ND | 118 | 89.2 | ND | ND | ND | ND | ND | ND | 207 |
| 2-3-83 | 1902 | 6.41 | 5.23 | ND | ND | 19 | 269 | 8.17 | 2.4 | ND | ND | 2.4 | ND | 313 |
| | 2117 | ND | ND | ND | ND | ND | 19.9 | ND | ND | ND | ND | ND | ND | 19.9 |
| 2-4-83 | 1836 | 2.79 | 4.28 | ND | ND | ND | 221 | 6.09 | ND | ND | ND | ND | ND | 234 |
| | 1915 | 3.57 | 5.09 | ND | ND | ND | 227 | 7.15 | ND | ND | ND | ND | ND | 243 |
| | 1937 | ND | 8.22 | ND | ND | ND | 236 | 8.25 | ND | ND | ND | ND | ND | 252 |
| | 2011 | 2.41 | 5.63 | ND | ND | ND | 247 | 7.92 | ND | ND | ND | ND | ND | 263 |
| | 2225 | 2.4 | 4.69 | ND | ND | ND | 198 | 5.99 | ND | ND | ND | ND | ND | 209 |
| | 2251 | ND | 5.09 | ND | ND | ND | 196 | 6.58 | ND | ND | ND | ND | ND | 208 |
| | 2320 | ND | 2.8 | ND | ND | ND | 169 | 4.65 | ND | ND | ND | ND | ND | 174 |
| 2-5-83 | 0813 | ND | 14.2 | ND | ND | ND | 263 | 4.58 | ND | ND | ND | ND | ND | 282 |
| | 0838 | 3.0 | 10.7 | ND | ND | ND | 336 | 10.6 | ND | ND | ND | ND | ND | 360 |
| | 0912 | 1.5 | 14.1 | ND | ND | ND | 285 | 11.7 | 5.5 | 5.5 | ND | ND | ND | 322 |

[a] ppmv-C = parts per million by volume as carbon quantitated against propane.

[b] ND = not detected. Detection limit is 3.0 ppmv-C.

[c] Total for all $C_7$ + compounds.

APPENDIX D

GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS) RESULTS

Appendix D contains the results of GC/MS analyses of incinerator inlet and catalyst outlet gas samples. These samples were collected during coating operations using Product B. No GC/MS samples were collected during the short period that Product A was run. Table D-1 lists the major compounds identified in the gas samples, the level of confidence at which they were identified and corresponding concentrations.

The GC/MS data is used primarily as a source of qualitative information. The compounds listed in the table all have an identification confidence level associated with them. These confidence levels are defined as follows:

Level 1 - Compound is definitely present. Retention time and mass spectra match known standards.

Level 2 - Compound is probably present. No retention time standard is available but mass spectra match well with library spectra.

Level 3 - This compound represents the best guess for the data available. This could be identified as another compound with the same molecular weight.

The concentrations reported are calculated against a toluene response factor, and are reported as toluene. These concentrations should be viewed only on a semi-quantitative basis. Concentration data should be used primarily for comparing the relative amounts of one compound to another within the same sample.

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TABLE D-1. RESULTS OF GC/MS ANALYSES OF GAS SAMPLES COLLECTED AT PLANT C-4 (Concentrations are given in ppmv quantitated against toluene)

| Compound | Identification Confidence Level | Concentration (ppmv) Incinerator Inlet | Catalyst Outlet |
|---|---|---|---|
| 1-Butene | 2 | | 0.82 |
| Acetone | 2 | | 0.09 |
| Isobutyraldehyde | 2 | | 0.08 |
| n-Hexane | 1 | 3.1 | |
| Butyl alcohol | 2 | 27 | |
| Ethoxyethanol (cellosolve) | 3 | 20 | |
| Methyl isobutyl ketone | 2 | 56 | 1.2 |
| Toluene | 1 | 7.1 | 0.11 |
| n-Butyl acetate | 3 | 23 | |
| Ethylbenzene | 1 | 20 | 0.23 |
| m/p xylene | 1 | 34 | 1.06 |
| o-Xylene | 1 | 30 | 0.27 |
| 2-Ethoxyethyl acetate | 3 | 32 | |
| Trimethylbenzene | 2 | 5 | 0.10 |
| Trimethylbenzene | 2 | 3 | 0.09 |
| Isophorone | 1 | 17 | |

# APPENDIX E

## RESULTS OF MOLECULAR WEIGHT DETERMINATIONS

The results of fixed gas analyses and molecular weight determinations for the inlet and outlet gas streams of the incinerator are given in Tables E-1 and E-2.

TABLE E-1. FIXED GAS ANALYSES AND MOLECULAR WEIGHT DETERMINATIONS FOR INLET GAS

| Date | Time | $CO_2$ (%) | $O_2$ (%) | $N_2$ (%) | Dry Molecular Weight |
|---|---|---|---|---|---|
| 2-4-83 | 1917 | 1.12 | 20.4 | 78.9 | 29.0 |
| | 1927 | 1.02 | 20.6 | 78.3 | 29.0 |

TABLE E-2. FIXED GAS ANALYSES AND MOLECULAR WEIGHT DETERMINATIONS FOR OUTLET GAS

| Date | Time | $CO_2$ (%) | $O_2$ (%) | $N_2$ (%) | Dry Molecular Weight |
|---|---|---|---|---|---|
| 2-4-83 | 1455 | 1.76 | 18.3 | 80.0 | 29.0 |
| | 1503 | 1.89 | 18.8 | 79.3 | 29.1 |
| | 1517 | 1.97 | 18.5 | 79.5 | 29.1 |
| 2-5-83 | 1004 | 1.45 | 18.3 | 80.2 | 29.0 |
| | 1015 | 1.96 | 17.8 | 80.2 | 29.2 |
| | 1023 | 2.00 | 18.1 | 79.9 | 29.0 |

APPENDIX F

EXAMPLE CALCULATION OF DESTRUCTION EFFICIENCY

Destruction efficiencies for Plant C-4 were calculated from incinerator inlet and outlet THC mass flowrates as follows:

$$DE = \frac{Min - Mout}{Min} \times 100\% = [1 - \frac{Mout}{Min}] \times 100\% \qquad F\text{-}1$$

where DE = destruction efficiency, %

Min = inlet THC mass rate, g C/sec

Mout = outlet THC mass rate, g C/sec

THC mass rates are based on measured Method 25A concentrations and gas flowrates:

$$M = \frac{(V) \text{ moles C}}{10^6 \text{ moles gas}} \times \frac{12 \text{gC}}{\text{mole C}} \times \frac{\text{mole gas}}{0.024 \text{ m}^3 \text{ gas}} \times \frac{(Q) \text{ m}^3 \text{ gas}}{\text{sec}} \qquad F\text{-}2$$

where M = THC mass rate (inlet or outlet) g C/sec

V = THC concentration (inlet or outlet), ppmv

Q = gas flowrate (inlet or outlet), $Nm^3$/sec